

# The challenges of agriculture: Feeding the world of tomorrow, on a transitioning and endangered Earth

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**Abstract:** The challenge is now and for the future: which agriculture is needed to adequately and sustainably feed a population that is still growing exponentially while respecting the planet? Ensuring food security for nearly 10 billion people, a considerable challenge, especially since many factors combine and tend to hinder tomorrow and today's requirements. It's hard to name them all. However, demographic, climatological and cultural variables appear to be the main threats to food security. Indeed, it is difficult to talk about food and agriculture without mentioning the demographic context, even if all countries are currently on the road to demographic transition<sup>1</sup>. On this subject, there is still a debate between Malthus' supporters, for whom food production will be unable to meet future demand given the available agricultural resources, and those who support abundance, for whom development is significantly possible thanks to scientific advances. This questioning can only be studied on a global scale. In fact, sustainable development can only be the result of joint political actions, both multidisciplinary and transdisciplinary, which will be successful thanks to a consensus. This approach consists, on the basis of the current situation and case studies, in determining the effects to address requests and possibilities.

**Keywords:** environmental requirements, food security, nutrition food, sustainable agriculture, sustainable development

## Introduction

Food security is a right. The UN Constitution identifies access to adequate food as an individual right and a collective responsibility<sup>2</sup>. Therefore, a crucial concern must be taken into account: to ensure the best preservation and distribution of available resources, to transform our production methods, while reducing environmental impacts. In this area, the situation is still alarming<sup>3</sup>, as the prevalence of malnutrition in all its forms is worsening in many countries<sup>4</sup>. There are 22 countries facing protracted crises, which could jeopardise the Zero Hunger Objective and Sustainable Development Goals by 2030.

In reality, food exists in part thanks to the yields of the "green revolution". The real problem is the accessibility of this food, which depends on far too many conditions and factors, only some of them will be addressed. As a result, contrasts are lost between countries with large agricultural areas and those with smaller exploitable areas that invest in foreign land. Thus, while some people sell their land to foreigners to develop its economy, others ensure their food security and sovereignty. Food becomes a marketable value, open to the world market and to "food speculation" linked mainly to the state of supply and demand.

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<sup>1</sup> On 1 January 2019, the earth's population was 7,637 billion. Growth is expected to slow down around 2050 (World Population Prospects Table, UN website)

<sup>2</sup> Further developed 20 years later, in 1966, by the International Covenant on Economic, Social and Cultural Rights (ICESCR) through the United Nations General Assembly

<sup>3</sup> Table of the new UN report, July 2019, by the leaders of FAO, WFP, IFAD, UNICEF)

<sup>4</sup> 820 million people suffer from hunger, 1.3 billion do not have access to sufficient nutritious food and more than 670 million are obese!

In a similar way, the notion of urbanization and its multiple effects on the countryside takes a prominent place. This phenomenon has led to a change in eating habits, to mention only the increasingly massive consumption of meat products, which are expensive in terms of land, water, energy and environmental impact. Productivist agriculture has had the merit of having considerably increased world agricultural production, yet it has generated many negative consequences. Today, agricultural production is partly responsible for and partly victims of global warming.

Therefore, it is not a question of imposing a sustainable agricultural model on all the world's farmers, but rather of accompanying or encouraging different measures adapted to national, regional and local situations, while maintaining as a common objective sustainability in its various components and the optimization of production conditions. A society of lower consumption, known as "moderation" of socially acceptable ethical limits would have to be considered. What is at stake? A reconsideration of consumerism and the establishment of inclusive, sustainable production methods, bearing in mind that the cultivable area cannot be extended under penalty of environmental pressure. None of the proposed innovations should be neglected and all should be analysed. Never before has the world community had so much knowledge, resources and technologies at its disposal to ensure that everyone has the food they need. We would expect from everyone a participation, a responsible engagement, for a land of solidarity.

### **Food. Update on the current world situation: better but still insufficient**

Since the dawn of humanity, eating has been a major concern. Food is far from being a trivial act, it is nowadays based on an economy, a complex system that includes all sources of agricultural or aquaculture production and involves many actors, activities and approaches of all kinds, sometimes unexpected and always in interaction. It would require a systemic approach.

### **Food and food security concept**

It is difficult to talk about food without mentioning and defining the concept of food security, which has evolved over time and in debate and is related not only to the availability of food but also to its accessibility. The Rome Declaration on World Food Security and the Plan of Action of the World Food Summit in 1996 set out a common goal: food security at the individual, family, national, regional and global levels:

*"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".<sup>5</sup>*

### **Food - a major concern in the world - became, after the Second World War, an international fundamental right**

This post-war world then experienced serious difficulties, transformations, geopolitical, economic and social upheavals; an unprecedented acceleration of the means of communication. Over the decades, there will be more and more talk of globalisation and the "village world". The effects will be significant on food availability in many countries that are first described as Third World countries, underdeveloped before being, for some, emerging and for others developing or developed and in which populations will be extremely food insecure. These incidences will act as levers for raising awareness and the need to act as quickly as possible to avoid moving towards more serious conflicts, as well as for the very security of all nations.

In the maze of all the legal data, commitments and declarations that followed, it is enough, to make it simple, to trace the main steps and aspects. United Nation, from its inception, has recognised access to adequate food as both an "individual right and a collective responsibility. "The Universal Declaration of Human Rights (1948) proclaims that:

*"Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing, medical care and necessary social services;..."<sup>6</sup>*

<sup>5</sup> Rome Declaration on World Food Security and paragraph 1 of the Plan of Action of the World Food Summit of 13-17 November 1996, Rome. Personal translation.

<sup>6</sup> Article 25/1 of the universal declaration of human rights

Just under 20 years later, the International Covenant on Economic, Social and Cultural Rights of 16 December 1966 enriched these concepts by recognising the right of everyone to have access to adequate food, and the fundamental right of « *everyone to be free from hunger.* »<sup>7</sup>

From then on, and in view of the global context, meetings in various forms, international conferences will follow one another. Governments, various international institutions, the Food and Agriculture Organisation (FAO)<sup>8</sup>, together with other UN agencies IFAD (International Fund for Agricultural Development), WHO (World Health Organisation), WFP (World Food Program) and UNICEF (United Nations of International Children's Emergency Fund) and various NGOs will be active. The concepts defined in the previous articles will be completed and amplified.

### **The analysis of food security is becoming both quantitative and qualitative; it is expanding to include nutritional concepts, but the urgency is still there**

In 1974, the International Conference solemnly proclaimed that « *Every man, woman and child has the inalienable right to be free from hunger and malnutrition in order to develop fully his physical and mental faculties.* » In the late 1970s, FAO listed low-income food-deficit countries (LIFDCs) to facilitate analysis and discussion of food security issues. But it was during the World Food Summit, from 13 to 17 November 1996, that the evaluation was much broader. "Food for all" is the theme announced by Jacques Diouf, Director-General of the Food and Agriculture Organisation of the United Nations<sup>9</sup>, on 1 February 1996 in Rome, at the launch of the Summit's campaign. Prospects are given through a global food action plan in seven commitments, of which point number two states :

*"We will implement policies to eradicate poverty and inequality and improve physical and economic access for all, at all times, to adequate, nutritionally and healthily adequate food and its effective use. »*

The concept of food security here covers four main pillars: availability, accessibility, stability and utilisation, whose multiple interactions make it more complex and compromise the expected results. The Action Plan provides for a reduction in the number of undernourished people in twenty years and for the first time there is talk of taking into account the phenomena of malnutrition, the problems caused by deficiencies, not to mention the trends towards obesity in all countries. Underweight maps are produced. On 16 and 17 November 2009, another world summit on food security in a context of global crisis, food insecurity and unbearable increases in food prices. It is always about eradicating hunger; establishing a more effective food security governance system with rules, mechanisms without specifying either the timetable or financing, leading to scepticism and doubt. It is also clear that the implementation of the Action Plan requires the participation of the stakeholders themselves, otherwise they will only be major declarations with no concrete effects.

### **Possible objectives set for greater efficiency**

Food insecurity has become regionalised, moving from the country to regions, from the city to neighbourhoods, from families to individuals... These developments exist even in developed countries. The results are slow, it is difficult to stick only to declarations of good conscience. The measures call for a timetable. In September 2000, the Millennium Declaration was adopted by 189 States at the United Nations General Assembly. The roadmap and timetable set out the Millennium Development Goals (SDOs) from 2000 to 2015<sup>10</sup>, eight goals to measure results and their progress through regular reporting. The first objective is to eradicate extreme poverty and hunger. They will provide a framework for the 17 sustainable development goals (SDOs), from 2015 to 2030, which should better meet the challenges of today's world, the second being zero hunger<sup>11</sup>. Every year, a leading publication, for all audiences: *The state of Food Security and Nutrition in the World*, presents global progress in the fight against hunger (SDOs, Zero Hunger), achieving food security and improving nutrition. According to the latest UN report, 2019: *To protect against economic slowdowns and downturns*, which are mixed and even alarming in some regions.

<sup>7</sup> Article 11 of United Nations Pact I, which entered into effect on 3 January 1976. On 10 December 2008, an Optional Protocol, which entered into force on 5 May 2013, established an individual complaints procedure.

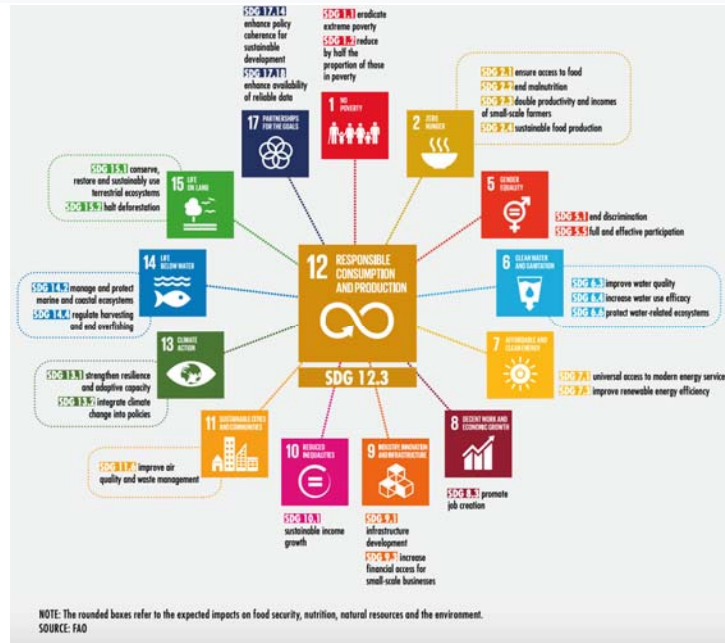
<sup>8</sup> Founded in Quebec City, Canada on October 16, 1945

<sup>9</sup> He held this position from 1994 à 2011

<sup>10</sup> The Millennium Summit was held from 6 to 8 September 2000 at United Nations Headquarters

<sup>11</sup> Programme adopted by the political leaders of 193 countries in September 2015 at the United Nations

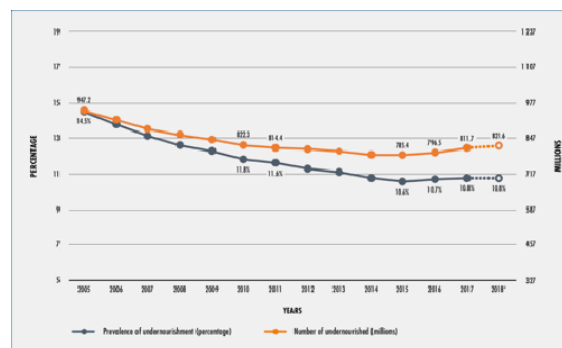
Figure 1 : The 17 sustainable development goals



There has been an overall improvement in world hunger, if food security has increased; at the national and increasingly regional level, the risk still exists and is on the rise, as the commitments made are so difficult to meet, there are too many obstacles to their implementation. Moreover, food demand and supply are too dependent on multiple and complex interacting factors; too many national self-interest, inertia and voluntary locking of the system. What is more, the concept of food security covers two different meanings depending on the type of country. For developing countries, it is a question of having quantitative and qualitative access to food and drinking water. For developed countries, it is a question of health security.

The very unequal relationship to food among nations, regions, families and individuals generates different situations ranging from hunger, overweight, obesity, under-or over-food, under-or over-nutrition. The analysis of these situations makes it possible to determine the level of food security or insecurity and that of malnutrition, it's more or less harmful risks on populations and individuals. What is the real situation on the ground?

Figure 2: Prevalence of Undernourishment (percentage of population) Source FAO: The State of Food Security and Nutrition in the World in 2019 (p.6 french report)



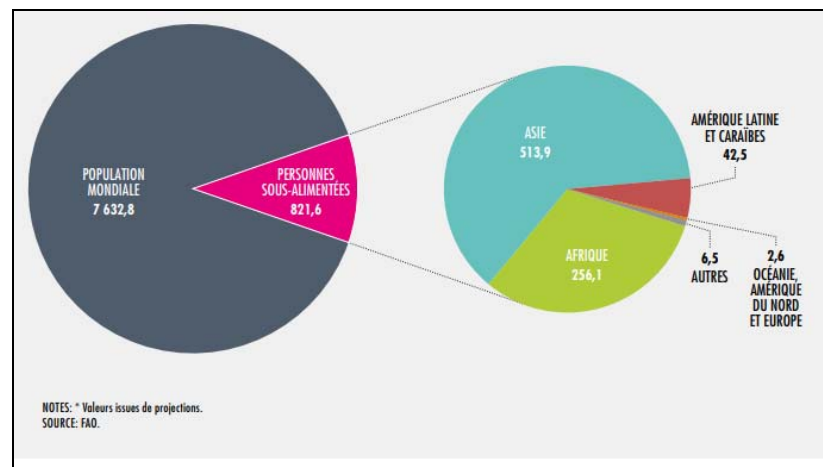
“Notes: Values for 2018 are projections as illustrated by dotted lines and empty circles. The entire series was completely revised to reflect new information made available since the publication of the last edition of the report. It replaces all series published previously.” Source FAO

Food insecurity is still a threat to many people around the world. Overall, the figures prove it<sup>12</sup> 22 countries around the world are facing protracted and therefore chronic food crises. According to the latest SOFI report of July 2019<sup>13</sup>, still published jointly (FAO, IFAD, WHO, WFP and UNICEF), within the framework of the SDOs, estimates for 2018 are 821.6 million people suffering from chronic malnutrition, or 11% of the world population; 1.3 billion do not have access to nutritious food. After a more or less marked decrease from 2003 to 2014, there is an increase that continues, according to estimates, in 2018, confirmed in all countries of the world, with variables .

**Figure 3:** Number of undernourished people in the critical regions of the world (in millions) and variation. 2018 figures are projected values. Personal construction according to FAO figures

Regions	2010	2015	2018	Variations 2010-2018
Africa	199,8	217,9	256,1	+ 56,3
Asia	572,1	518,7	513,9	- 58,2
Latin America	40,7	41,7	42,5	+ 1,8
Oceania	1,9	2,5	2,6	+ 0,7
World (do not add up)	822,3	785,4	821,6	- 0,7

**Figure 4 :** Distribution of undernourishment worldwide (in millions) 2018\*. Source FAO: The State of Food Security and Nutrition in the World in 2019 (p. 14 French version)



<sup>12</sup> Depending on the source, the calculation methods change. To avoid adding too much complexity, we have confined ourselves to the sources of the United Nations agencies already mentioned.

<sup>13</sup> First SOFI Flagship Report 1999

It would be futile to use the data from most of the countries concerned to focus only on those countries that seem to us to be the most convincing or that correspond better to our knowledge and to a certain proximity.

In absolute terms, Asia currently has the highest number of undernourished people, with nearly 514 million living in Asia. As a percentage of the population, Africa has the highest proportion of undernourished people 19.9% and more than 30% in East Africa! At the national level, Uganda, Nigeria or Sudan have experienced a significant increase in chronic undernourishment, with 41% of the population (17.6 million people), 13.4% (25.6 million people) and in Southern Sudan, 54% of the 6.35 million people are still facing serious food insecurity, warned FAO, UNICEF and WFP in September this year (2019).

According to UN agency figures, the number of undernourished people in Africa has increased by more than 56 million since 2010, while it has decreased by almost as much in Asia, less than 58 million, the decrease here seems to be stabilising. For the Middle East and more specifically Lebanon, estimates are 11% of the total undernourished population; in Jordan 12.2% (conflicts and refugee flows). As for Yemen, nearly 40% of the population is undernourished (war). No quantified data for Syria and Libya.

The prevalence of undernourishment and/or malnutrition may be severe or moderate or transient. The consequences are undoubtedly detrimental to children: wasting, stunting in children under 5 years of age (over 150 million) and for women of childbearing age (anaemia). At the opposite end, we have the prevalence of overweight, obesity for children and adults (1.9 billion overweight, about 670 million obese).

In all countries, generally and non-exclusively, a twofold set of factors affect and can worsen food security and thus the ability to provide sufficient and healthy food for their populations. Structural factors concern the country's opportunities, capacities and means of individuals; conjunctural factors depend on nature, climatic hazards and disturbances, natural disasters, soils and crop depredation. It is a fact that in many parts of the world, particularly in Africa, production and yield are insufficient, de facto accentuating import dependence; not to mention a purchasing power at half mast! The result is an unequal distribution of food resources, which is found, to a much lesser extent and for partly different reasons, in rich countries where there are significant pockets of poverty and difficult access to food, even if the figures, in comparison, seem minimal; still according to the same sources, the prevalence of undernourishment among the populations of North America and Europe is less than 2.5%.

### **The prevalence of undernourishment (PoU and IAgave) is comminatory in Africa**

With regard to the prevalence of undernourishment, Africa is the most worrying continent, one that requires all the international attention but above all European and French attention, because of - above all - history. The alarming situation here results from the conjugation and all too often activated correlation in a closed circle of the given factors previously combined with other multiples and complexes. Many countries suffer from an unstable political situation, punctuated by numerous crises; suffer from inadequate political and economic choices; endure wars and civil and tribal conflicts, without forgetting the cultural and religious weight and what the latter implies in terms of conflicts, terrorism, horror..., food used as a weapon of war, a recruitment tool for extremists and Africa become a backbone of various jihadist groups. Insecurity and vulnerability are the lot of many African countries, including many segments of the population. The list is impressive and could eventually become explosive for Africa itself and its neighbours, with France and southern Europe at the forefront.

Population growth is also included in this list. A majority of African countries suffer from the vicious circle: population growth, poverty, difficult access to "adequate food", food insecurity, and insecurity. Niger, Angola, Somalia, Democratic Republic of Congo, Mali, Nigeria, Uganda, Ethiopia, Tanzania, South Sudan, Equatorial Guinea... are currently experiencing the highest population growth rates, the highest fertility rates in the world.<sup>14</sup>

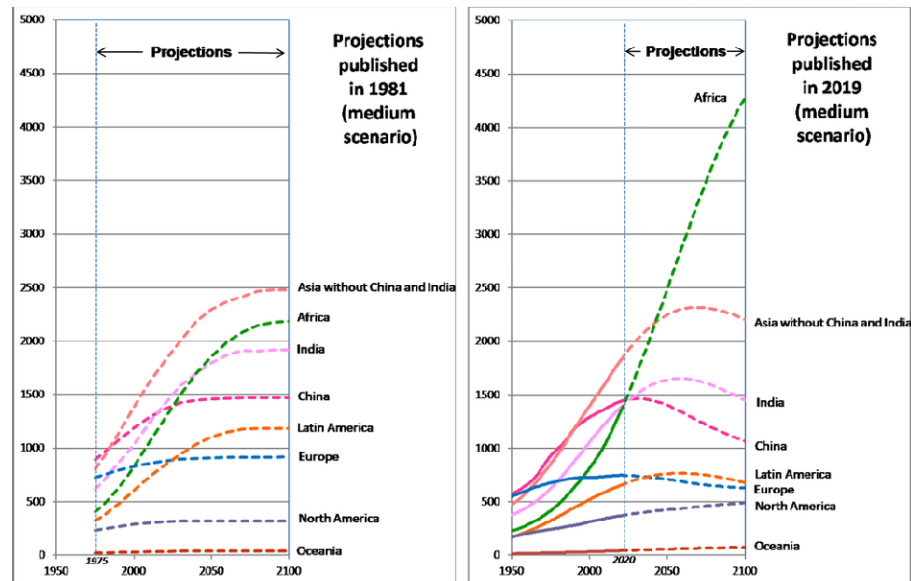
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<sup>14</sup> Fertility rate in the world 2.5; it is 4.35 on average in Africa.

**Figure 5 :** Personal construction according to the FAO: “*World Population Prospects. United Nations, 2019*”. The figures presented here correspond to the projections for the current year. » (personal translation)

Country	Total population (thousands)	Birth rate	Infant mortality rate	Number of children/women
Africa	1 308 064	<b>33,0</b>	<b>45,4</b>	<b>4,35</b>
Latin America & Caribbean countries	648 121	16,1	14,9	2,02
North america	366 601	11,8	5,6	1,75
Asia	4 601 371	16,0	23,8	2,13
Europe	747 183	<b>10,2</b>	<b>3,9</b>	<b>1,61</b>
Oceania	42 128	16,4	17,3	2,34
World	<b>7 713 469</b>	<b>18,2</b>	<b>28,1</b>	<b>2,45</b>

According to a United Nations projection, Africa would account for 54 per cent of the increase in world population between 2015 and 2050 and 83 per cent of the increase between 2015 and 2100. In 2019, Africa had 1.3 billion inhabitants, or 17% of the world's population. The consequences are dramatic in that they only include the increase - at the risk of their lives - in the number of various migrants. This is a problematic emigration for the host countries but also excessively damaging for the countries of departure, which are losing their vital forces, their brains. To be more accurate, and contrary to the popular perception of such off-continent migration, intra-African travel is higher. According to UN statistical estimates, between 2015 and 2017, the number of African migrants in the region increased from 16 million to about 19 million. During the same period, the number of Africans leaving the continent increased from about 16 million to 17 million.

**Figure 6** : Comparison of population in 1981 and 2019. Gilles Pison based on UN date, CC BY-NC-ND

Note: This comparison is extracted from the article of Gilles Pison<sup>15</sup>: «*Haw many humans tomorrow? The United Nations revises its projections* ».Article published by the Conversation France.

Does the world have enough food and is it accessible to all?

### **The right to safe and nutritious food can only be applied according to its actual availability and accessibility**

The evolution of human eating habits, lifestyles and consumption in a context of strong urbanisation, globalisation and increasingly uncertain economic standards have had significant effects on the agricultural availabilities that should be devoted to food. The acceleration of urbanisation in Asia and Africa<sup>16</sup>, where growth and rural exodus combine to create anarchic situations that are difficult to manage, the effects are multiplied by a lack of cohesion, preparation and anticipation, resulting in slums, poverty, lack of food and all the elements of food insecurity. Competition is fierce with animal feed correlated with the increase in the consumption of meat and dairy products worldwide and with the growing demand for biofuels.

Only 60% of the world's crops are used to feed humans, 35% of the world's production is used to feed livestock, and 5% is used to produce biofuels and other industrial products including textiles. According to the World Bank, almost all of the increase in global maize production from 2004 to 2007 was absorbed by biofuel production in the United States. This significantly reduces the amount of food available to humans.

According to many experts, food exists, world cereal production has almost doubled since the early 1960s and general production would be able to meet the food needs of all human beings<sup>17</sup>. We produce the equivalent of 4,500 calories per person and per day, we need on average 2000 to 2500 calories. Not to mention that one-third of the world's food for human consumption is wasted, or 1.3 billion tonnes of food per year. More than 41.200 kilos of food are thrown away every second in the world. In France, it is estimated that nearly 10 million tonnes of consumable food are thrown away each year.



It is therefore not a lack of food but a poor distribution. A more egalitarian distribution is indeed desirable, but it is not enough if it is not accompanied by many other conditions, in particular purchasing power.

Financial resources are one of the main factors that determine access to food. In the food and market pair, food prices make access to food difficult or even impossible for the poorest populations. It is taxing their budget. Daniel Gustafson, then Director of the FAO office, noted in November 2009 that:

*« The problem of hunger was already serious when food prices were reasonable and that the world was living in a period of prosperity. But the global food crisis (2006-2008), followed by the economic crisis, has created a catastrophic situation. »*<sup>18</sup>

He referred to the « hunger riots » linked to the soaring agricultural prices, undermining the preconceived idea of « *market self-regulation* ». The very low level of stocks has played an important structural role. In one year, an additional 100 million people were hungry. It is true that people in poor countries spend more on food than those in rich countries; 50 to 80% for the former, 10 to 20% for the latter, about 7% in the United States. In 2012, 2014 the United States Department of Agricultural Economics (USDA) prepared an informative map on this subject.

What about the global food market on the accessibility of food?

**The increase in the price of agricultural products is based on many criteria whose complex workings are difficult to assess, define and fix.**

Globalisation, the emergence of certain agricultural powers, the increase in demand, production capacities, the search for market shares, climate change, etc., are occurring to varying degrees and at different levels. All of this has led to increased trade rivalries at a time when food demand is increasing. It is certainly not a question of taking up the history of trade in agricultural commodities but of marking the main facts. The agricultural power held by the United States since the end of the Second World War was hampered in the 1960s by the food self-sufficiency of the European Economic Community (EEC). Thanks to the Common Agricultural Policy (CAP), the EEC has been able to generate surpluses, export — above all cereals — and through opportunities to become a real export power. Demand for agricultural products increased, notably in the oil-producing countries of the Middle East, enriched by the oil shocks. In such a context of rivalries, difficulties soon began to accumulate in the so-called Third World countries, most of which had undergone decolonisation and have recently become independent.

« *Volcker's policy* », which consisted in raising interest rates and the dollar exchange rate to curb American inflation, in 1981 and 1982, had serious repercussions on the above-mentioned countries; their indebtedness reached levels that were difficult to bear and repay, with further exacerbated poverty and food insecurity.

According to the World Bank, the debt burden of Sub-Saharan Africa was \$70.3 billion in 1982<sup>19</sup>, and \$139.6 billion in 1988; in East Asia and in the Pacific, it increased from \$124.8 billion to 206 within the same period.

From the mid-1990s, under pressure from the GATT, commodity markets were deregulated and further liberalised. Thus, in 1994, the European Union negotiated, during the last GATT agreements, the gradual abandonment of Community preference and the opening of all sectors to the world market. The result is a succession of food crises and poor people have seen their access to food become harder and harder because of a drastic reduction in their purchasing power.

The establishment of a « food speculation » market is a more incisive factor, and its effects on the access to food can be disastrous. The best evidence of this speculation is that at the time of the US housing crisis, which began in 2006, bankers and traders reportedly withdrew billions of dollars from real estate investments and to plow them back into food financial markets. A foodstuff is thus treated as a raw material in the same way as, for example, oil. As it opened to the world market, it became a marketable value, subject to speculation and its mechanisms. All this depends on supply and demand; both are very closely subject to climatic phenomena, to increasingly just-in-time stocks or, more often than not, speculatively manipulated stocks and to the economic trade policies of States.

The financialization of the agricultural sector implies a more or less important use of financial instruments at the risk of developing dramatic uncontrolled speculation for access to food. Price trends have a direct impact on global food security. The memory of the « *hunger riots* » in 2007-2008 in about thirty States, some of which were more than 90% dependent on world imports is striking enough. This raises awareness of the need for restrictive measures and effective supervision of these instruments, of the need to go beyond the various national or international compromises; to act as best as possible on the vulnerability and volatility of agricultural products. Thus, market price trends for staple foods such as cereals, oils, dairy products, meat and sugars are monitored by national and international bodies such as the UN and its various agencies; the FAO coordinated with the Agricultural Market Information System focuses on the prices of rice, wheat, soya and maize; the WTO, etc.

Food prices on world markets, in constant value, fell considerably between the early 1960s until and all-time low in the early 2000s. They increased slowly from 2003 to 2006, then more sharply since mid-2008; they have not stabilised since then.

However, lowering prices does not seem to be the solution. It only exacerbates the conflict between the interests of rural populations who live off agriculture and those of urban populations who need access to food at a fair price. Other measures would be desirable at the risk of hitting the concentration of powers exercised by large multinationals.

### **Food in globalisation, in the hands of a few multinationals**

Upstream and downstream of agricultural, forestry and aquaculture production, there is only a small number of actors. A few multinationals dominate the food, agri-food and distribution sectors, mostly from the USA and the European Union and a few in emerging countries (Brazil for meat). The important thing is not to list them exhaustively but to note their weight, the main changes and their impact on food and nutrition.

They act as omnipotent lobbyists, as true oligopolies. Seeds, fertilisers, tools and machines, a whole production today under the control of a small number of multinationals. Six firms dominate 75% of agrochemical production. Four major cereal companies - three American and one French: "ABCD companies": Archer Daniels Midland (ADM), Bunge, Cargill and Louis Dreyfus practically monopolize most of the international trade in basic foodstuffs, including nearly 90% of cereals. Bayer, the German group that recently absorbed the American Monsanto, is one of the most important, if not the first, for seeds and pesticides. The Frenchman, Limagrain, an international agricultural cooperative group led by French farmers, specialises in the creation, production of plant varieties and the marketing of seeds. ConAgra Food recently Conagra Brands is one of the leading American food groups. Ten companies dominate the food sector: Nestlé, Pepsico Unilever, Coca-Cola, Mars, Mandelz International, Danone, General Mills, Associated British Foods, etc. Some major supermarket chains, such as Wal-Mart, Carrefour and Tesco, have direct links with producers around the world. The list would be long and tedious.

Financialization and globalisation are pushing them to an intensive and dangerous concentration of their power. A multimodal concentration through "mergers and acquisitions", by associations and occasional<sup>20</sup> pooling, by diversification by encompassing more and more products, transformations, innovative technological support and promising and profitable prospects, such as laboratory crops. This intensification of power leads to extremely unequal power relations in the food chains, from producer to consumer, all the more so as this race towards the ever larger and more powerful underlies the very likely risks of transcending national or supranational control mechanisms.

Most of them, including the « ABCD » companies, joined by Glencore Agriculture Limited, are learning new technologies such as blockchain and artificial intelligence to "automate post-trade execution processes for grains and oilseeds". Their objective is to reduce the cost of moving agricultural and food products around the world and therefore the purchase price for the consumer, which is far from certain. The examples prove it. Moreover, taking into account the general system of globalisation of a product that is not, for various structural or other reasons, processed locally, its cost is substantially different from that of being processed locally, which is the common rule in many intermediate and developing countries.

Increased concentration of power has serious negative impacts on the unstable and fragile agricultural economies of middle- and developing economies. Apart from having imposed different eating habits, they maintain a competition that small producers, family agri-food companies and small traders in these same countries cannot withstand, especially in Africa! Think of the low-cost products and food surpluses exported from the North to the South, milk powder, low-cost, low-quality chicken cuts that have flooded African and southern markets in general from the European Union!

Abundance and diversity of food in such a system tend to be reduced, standardised and tend to become uniform. This leads to the erosion of plant, fruit and especially animal, terrestrial and aquaculture biodiversity. In 2008, FAO issued an alert denouncing the threat to domestic animals. In response to the race for productivity and yield, of the 6300 breeds, 1350 were threatened with extinction, some of which had already disappeared. A dozen animal species alone would provide 90% of the animal proteins currently consumed in the world with increasing genetic control and cost. All this does not make it a better quality meat! A few industrial giants occupy this sector, including the British Genus (cattle and pigs), the German Eric Wesjohann (EW Gruppe) (laying hens), the Dutch Hendrix Genetic (chickens and turkeys), the French Grimaud, the second largest breeder of poultry, rabbits and shrimps, and the American Tyson Foods via its subsidiary CobbVantress (broilers).

The balance sheet for food is not satisfactory and the « zero hunger » objectives for 2030 have not yet been achieved. If we are to avoid the serious sources of food stress and threatened environment that food inequalities represent in the near future, we must ensure food security for our generation and the next; this must be a vital political imperative.

This food inventory cannot be separated from that of agriculture. Every food system has its origin in agriculture. It is therefore one of the sources of explanations for this finding of food insufficiency for a large part of the world's population.

### **Observation on world agriculture**

Many actors are calling for a fundamental transition in food. These claims inevitably result from the transformations of current agricultural systems.

Several observations shape current food production patterns. Indeed, the capacity of food production tends to be limited by many factors that hinder agricultural production. Desertification, urbanisation, demographic, food and climate transition, scarcity of water resources, geopolitical conflicts, loss of biodiversity, drought and flooding are just some of the obstacles to overcome in order to meet the ever-changing food demand.

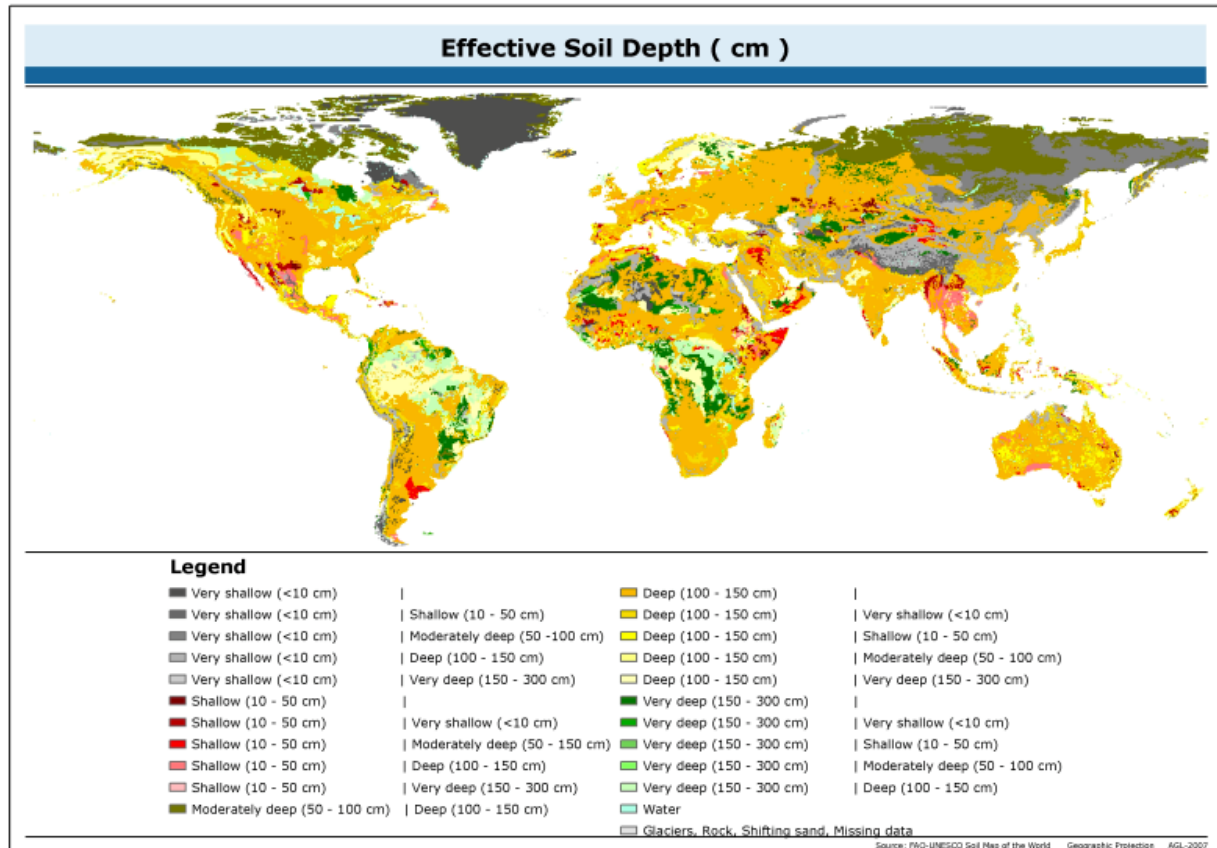
This section aims to provide an overview of the main agents that reduce agricultural production capacity. An essential step in order to inventory the current indices, lacking in the future food issues of the demographic challenge.

### **Soil, the strong link in the agricultural process**

Soil is a major resource for agriculture, it is the basis, because it allows the plants growth, so essential for animal and human nutrition. To be fertile and produce crops, it needs good biological activity.

Soil is none other than the surface of the earth, composed mainly of mineral and organic elements, whose components and characteristics diverge according to continental localities. For instance, climate data modify the plant and rock formations on which they develop, so thicker soils will be found in warmer regions and thinner soils in higher elevations.

**Figure :** Soils Map of the World. Geographic projective AGL-2007 by FAO - UNESCO



Many actors can come to modify its functioning and properties, human activities and climate variations are the main ones. Anthropogenic changes can be more or less rapid, some are very brief, such as soil compaction by machine passage.

Today, one of the most significant threats to agriculture and land productivity, particularly in Africa, is desertification. This phenomenon prevents their agricultural exploitation. More concretely, this refers to land degradation in arid, semi-arid and dry sbhumid areas. It simply manifests itself: degradation or even disappearance of vegetation and soil erosion. Human activities as well as the climate can be the cause. Desertification has a significant impact on biodiversity, and may in the coming years be exacerbated by water scarcity, which could lead to its development in many regions.

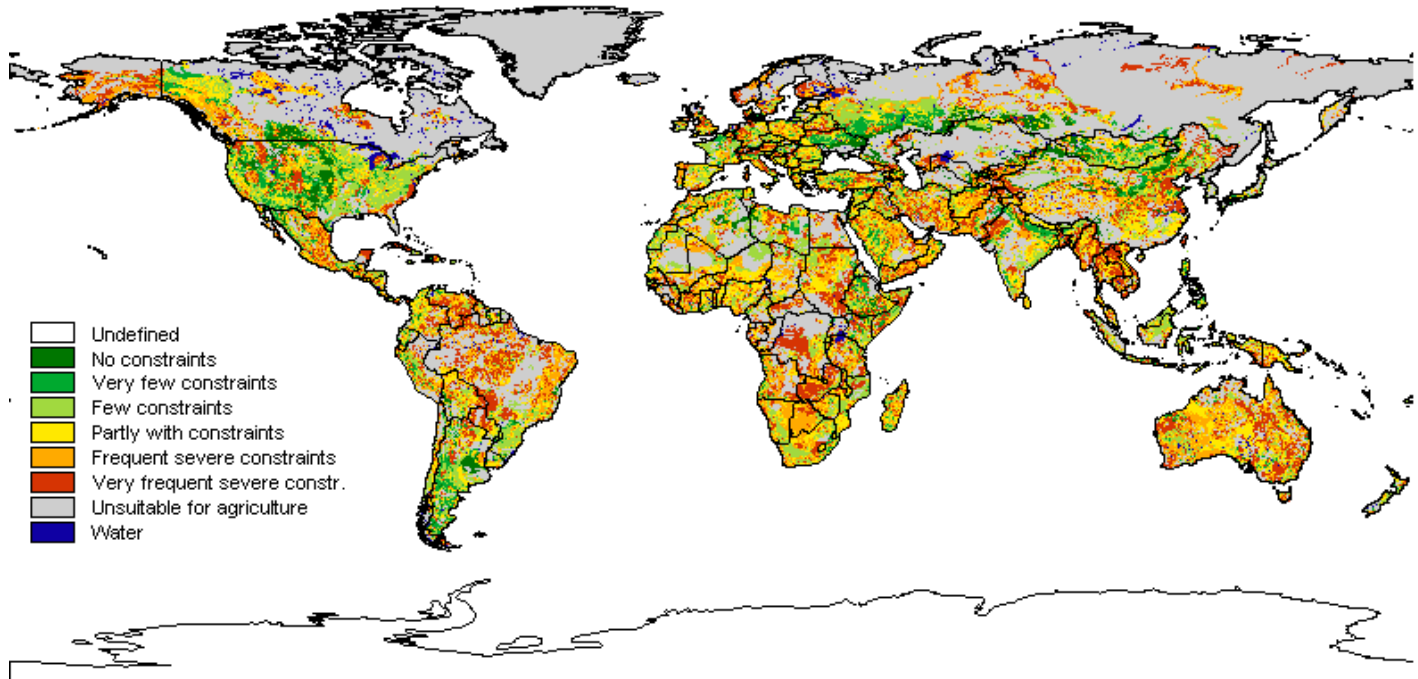
De facto, it goes without saying that climatic irregularities affect crop distribution, production and yields. Without adaptation, the world agricultural map will be significantly modified and the planet's productive capacities will be profoundly affected. Climate irregularities affect different sectors of agriculture and vary from region to region. Climate change increases temperature and precipitation variability, limits the predictability of seasonal weather patterns and increases the frequency and intensity of extreme weather events, such as floods and cyclones, among others.

As a result, some regions are expected to be exposed to prolonged droughts and water shortages. Massive melting of glaciers and snow cover in the main mountain ranges, particularly in Asia, will affect water flow and seasonality of water flows, which will eventually reduce the availability of irrigation water downstream. In addition, the increase and intensification of extreme weather events will have an increasingly significant impact on weather patterns and food production.

Land degradation, whether anthropological or climatological, will lead to an increase in international food prices, and an increase in the number of people exposed to food insecurity, as the deterioration worsens. De facto,

these events should not be underestimated as the socio-economic impacts will be felt in the face of demographic challenges, mainly among low-income rural populations and in countries heavily dependent on agriculture.

**Figure 8 :** Absolute evaluation of soil health. Combined soil stresses. Global vision of soil health. FAO



### Food production, its main forms to satisfy food demand

The satisfaction of human food needs is achieved through four main food systems in space and time.<sup>21</sup>

The first stage groups all activities carried out by man to obtain plant and animal products that are useful to him, in particular those intended for his food, it is the agricultural stage, very widespread in the world and in particular in the countryside, it is the original essence of food production, today perceived as self-sufficiency often linked to poverty.

Then there is the artisanal stage, it corresponds to the processing of the products resulting from the first and their marketing, the methods are often traditional and rudimentary, in opposition to the industrial one. Indeed, agro-industry is the next stage, the processing agro-industries take an increasing place and have a predominant role in the management of the entire food system. At this stage, 30% of the price of products is given to the initial producers, and 40% for these industries. This is the stage where mass production really begins. Finally, the ultimate stage is the agro-tertiary, here only 10% of the price is given to farmers, it is the same as the previous one, generally mass distribution. More precisely, it is the stage where food tends to become from an economic point of view, no longer material goods but services where almost half of the final price of the average food product is formed by services (transport, marketing (more than 10% of the price for advertising), bank interest, insurance Etc).

In 2019, the world is undoubtedly dominated by an agro-industrial and agro-tertiary food system, and growing concern about the feasibility of an alternative model appear. Because this intensive, financialized and globalised system has certainly enabled remarkable advances in terms of product prices and safety, but it is generating negative externalities that are already beginning to threaten the food balance of populations, and threatens the planet's ecological balance.

To illustrate the statements above and make them concrete, some general points can be made. Indeed, it is considered that the least developed countries (Tanzania, Bangladesh...) are at the agricultural stage. In the artisanal stage, we find low-income developing countries, such as Bolivia, or middle-income countries such as Brazil. OECD countries are at the agro-industrial stage. In France, the added value of agriculture and the agri-food industry levelled off in 1993, the share of catering outside the home in the consumption pattern was then 20%, even if there are still many small and medium-sized companies that process agricultural products, increasing importance is given to industries. The United States has been at the agro-tertiary stage since the early 1990s.

Among the top twelve global food companies, six are American (Coca, Pepsi, General Milks, Kellogs, Mars, Mondelez), and five are European (Unilever, British Food, Nestlé, Danone, Lactalis). Indeed, about ten countries account for 85% of the value of world production.

It is not easy to find your way around in all these areas, especially since the « *distance* » between the production of agricultural raw materials and the consumption of food produced from them is increasing. For a long time, a linear representation was favoured, the origin of which would be the producer farmer and the end the consumer destroyer of the final product. Today, the image of the food chain is often adopted, particularly by logisticians who speak of "supply chains" to refer to all the links that link the necessary supplies to the product delivered to satisfy the end customer's demand. As the latter has become « *king* », it is sometimes a centrist vision that is preferred. Thus, the consumer would no longer be the final element of the chain, he would now be at the centre and the "spokes" would connect him to each of the operators in the food chain.

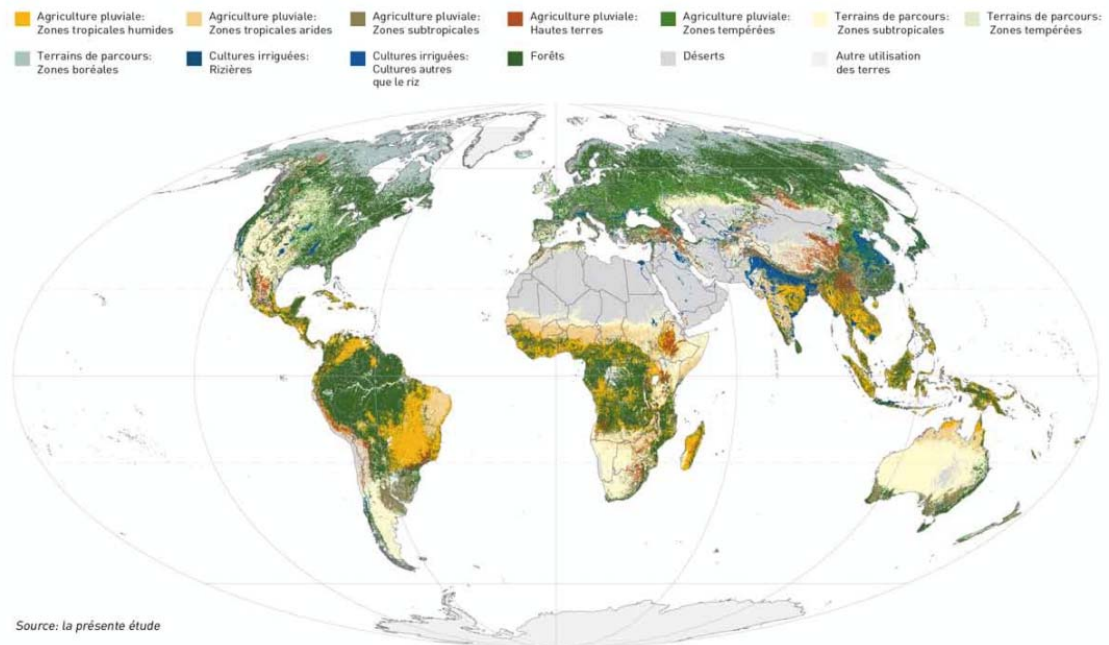
The notion of the « *food mile* »<sup>22</sup> makes it possible to determine the average distance travelled by a food product between its place of production and the consumer's plate. This "Food Miles" is on average 2400 kilometres because they transit via global firms and are opposed to those of local farmers who transit via short circuits.

Also, it is noted the impact of the food transition, and therefore the change in food behaviour has had a strong impact on agriculture. In addition, there has been a significant decline in demand for local smallholder farmers and food agriculture.

The increasing food demand for meat products is pushing farming systems to adapt to this mutation in the "livestock revolution", while meat farms are extremely expensive in terms of land, water, energy and grain. In 2017, a report points out that the twenty largest meat and dairy companies emitted « *more greenhouse gases in 2016 than the whole of Germany (...)* If these companies were a country, they would be the 7th largest emitter of greenhouse gases ».

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**Figure 9.** The main agricultural production systems. FAO, French synthesis report on the state of land and water resources for food and agriculture in the world.



### Privatisation of agricultural land, a new political and economic trend

« Land grabbing », or has him get his hands on the land, implies energetic and unfriendly action. For neo-liberal inspirations, land is an asset, a capital like any other, which can be treated as a commodity. Land markets will redistribute land in an economically optimal way if they operate without distortions. So, privatising land through sale or lease makes it possible to cultivate unused or under-utilised land, and thanks to investors, yield differences will narrow between countries, and production will be sufficient to feed the world and jobs will be created.

Nevertheless, on the contrary, for many organisations that are part of the classical economic tradition, there is something specific about land that cannot be considered as a commodity or capital. People express this specificity through expressions such as "*Mother Earth*", "*Demeter*", "*La Pachamama*". While there is an apparent consensus on the need to respect the rights of land users affected by land grabbing, there are divergent positions on the nature and basis of land and natural resource rights.

The appropriation of agricultural land is a new stage of globalisation, with arable land becoming increasingly synonymous with politically strategic resources. New relationships are being established regarding the takeover of agricultural land between investment host countries and foreign investors, public or private.

Since the 2000s, States, directly or through public fund companies, have been seeking, for political and geopolitical reasons, to better ensure their food security. For their part, private funds and firms anticipate possible profits from the sale of agricultural products or capital gains on agricultural land. Like a Monopoly game, the takeover of agricultural land in foreign countries is now developing on a global scale.

An economic strategy consisting in selling its products to develop its economy. In August 2008, Sudan published an offer to sell 880k hectares of leasable land, it being specified that 200k hectares had already been sold to Qatar, 30k to Abu Dhabi to produce rice and corn. Since 2006, sales or leases of agricultural land to foreigners have reportedly covered some 20 million hectares. These investments suggest a form of neo-colonialism because the

question arises of the loss of control over land by local companies, which could become a victim of such cooperation.<sup>23</sup>

Through offshore settlements, States are looking for a way to better ensure the food security of their population, which highlights the major geostrategic role they grant to the control of arable land. States buying or leasing agricultural land abroad are grouped in very limited geographical areas. The first group of countries is China, Japan and North Korea. Only China is reported to have taken control of 10 million hectares, particularly in Asia and Africa in recent years. A second group of countries includes the oil states to the South and the Mediterranean. It is important to point out that these two main groups correspond to the most grain-deficit geographical areas on the planet, and therefore will increasingly become so. For these countries, the aim is to ensure food security, which they believe is threatened by price volatility on the world market.

In Africa, the opportunities are enormous, 80% of arable land is still available. Some foreign powers have therefore seen this as an opportunity to be seized. Many countries have therefore appropriated thousands of hectares of land there, either to import agrofuels for Western countries or to guarantee a sustainable food supply for Asian and Gulf countries. Investments in African lands have been increasing since 2008, following the global crisis and hunger riots in Africa. It is important to note, however, that according to an IMF study, Sub-Saharan Africa has weathered the crisis better than others, thanks to its low integration into the global economy. This would mainly involve the production of cereals, wheat and maize, which account for about 70% of world demand.

China, which has about 1.5 billion inhabitants or 20% of the world's population, has only 9% of the world's agricultural land and 6% of the world's freshwater reserves, so it has seen an unexpected contribution for its present and future. De facto, large state-owned companies have begun to invest in rice, cassava and sesame plantations, notably in Tanzania, Senegal, Sierra Leone and Zambia. Some of the production is sold locally, the other exported to China. In Cameroon, a provincial agricultural company in China, Shaaxi Farm Agribusiness Corporation, negotiated an agricultural investment at the end of 2015, at the invitation of Cameroon and on Beijing's order. In 2019, an estimated 125 thousand hectares of agricultural land was occupied by China, and only in Cameroon. By 2030, China is expected to account for 35 to 40% of global production.

China is not the only country in this approach, far from it, with less than one million hectares of agricultural land in Africa, it comes far behind the major land buyers on the continent, which are the United Arab Emirates (1.9 million hectares), India (1.8 million hectares), the United Kingdom (1.5 million), the United States (1.4 million), and South Africa (1.3 million) J.

**Figure 10 :** Land Matrix interactive map, displays the spatial distribution of land deal locations. 14 November 2019





According to Land Matrix, an international initiative to monitor large-scale acquisitions of foreign land, 10 million hectares of land are cultivated by the Chinese outside their borders.

This massive purchase of agricultural land by foreign powers in Africa poses a serious threat to development, food security in the regions concerned, and a serious loss of income and food for the inhabitants of the African continent.

For some, Africa has not said its last word, it has enough to hold the major agricultural and food powers in the coming years. Charles Sielenou, agricultural expert and founder of African Social Action, which operates in the agricultural sector, explains:

*« For me, African lands are our own atomic bomb. It is our weapon of deterrence. There will be more than two billion of us in 2050. The world will have problems feeding itself. We have most of the agricultural land not yet in use. But we cannot take this opportunity to influence the geostrategic balance of power »*

Unfortunately, these appropriations lead to the destruction of peasant societies, excluding millions of small producers. The widespread local effects are worrying: despoilment of local populations and violation of their customary rights, unequal competition between large production units with very high capital and land endowments, and farmers producers whose labour productivity is much lower.

For the 9 or 10 billion human beings expected to have enough food and the energy resources necessary for life by 2050, the fight against peasant exclusion and the maintenance of as many small farmers as possible is a necessity.

Environmental stress and in particular climate stress can increase insecurity and instability in the territories. Users compete for resources, for example because of the natural decrease in supply, linked to the variability of natural conditions, may experience high tensions and conflicts, as detailed above. The inequitable distribution of the resource among users can lead to various crises

### **Conflicts, a vector of insecurity for agricultural territories**

This is not about land warfare, but about the impact of wars on agricultural land.

*« Maintaining peace and stability in each country is a prerequisite for achieving sustainable food security », <sup>24</sup>*  
World Food Summit Plan of Action, paragraph 3.

It is difficult to make an exhaustive inventory of global agricultural situations without addressing the issue of conflicts. While armed conflicts are responsible in the world for many victims, they are also the cause of environmental degradation and even destruction. They generate many famines and malnutrition. They justify a large number of population movements within and between countries, which can be exacerbated by the effects of climate change itself, affecting available resources.

Many expressions have recently become part of everyday language: do not we speak of "climate refugees" <sup>25</sup>, "environmental refugees" or "Eco-refugees"? Discourses on their number in the near future occupy an important place in the analysis of agricultural territories. Wars cause major climatological impacts, but also resource wars cause migratory flows generally to the nearest countries, or the sometimes massive arrival of refugees has significant environmental consequences. On the one hand, by increasing demand for diverse resources, including access to food, but also by social impacts.

There is a distinction to be made between the pre and post 20th century conflicts.

Armed conflicts and civil unrest were one of the major causes of food insecurity in the 1990s and will continue to be so. Globally, conflicts have affected hundreds of millions of people, the vast majority of whom live in low-income countries, in which agriculture plays an essential role as a means of subsistence, a source of income and a factor of social stability. A disproportionate number of the countries affected by wars are in sub-Saharan Africa.

The impact of conflicts on agricultural production is particularly evident, as the destruction of culture is best reflected in reduced food security and, at worst, deadly famines.

The impact of conflicts on agriculture must be analysed in the light of the nature of contemporary conflicts, which has evolved since the Second World War. Until then, wars were generally international ones.

Since the Second World War, international conflicts have been relatively rare and generally short (Iran Iraq war 8 years). Most contemporary conflicts are not between countries, but between a government and a political or military group that wants to overthrow the government or create an independent state. Generally, they do not involve two regular armies, but involve a complex confrontation between the government and different opposition movements that may be hostile to each other. In some countries, war is often waged by rudimentary technical means, small arms and landmines, which are particularly devastating to agriculture, preventing the exploitation of large areas of arable land until they are neutralised. In addition, beyond their effects on farmers' productive capacity, these conflicts often risk creating situations of food insecurity because they hinder the transport and distribution of food. The current example of Yemen is very revealing, for several years the country has been plunged into the heart of conflicts, blockades and bombardments have severely affected access to food supplies causing a famine situation in the country. The situation in Yemen is considered by many actors to be the "greatest humanitarian crisis in the world". A dizzying accumulation of figures, 16 million people need support in water, sanitation and hygiene, 1.8 million children and 1.1 million pregnant and lactating women are severely malnourished and 400k children under the age of 5 suffer from severe acute malnutrition. *"Today, when bombs do not kill (...) it is the lack of access to food or prices that take care of it."* »

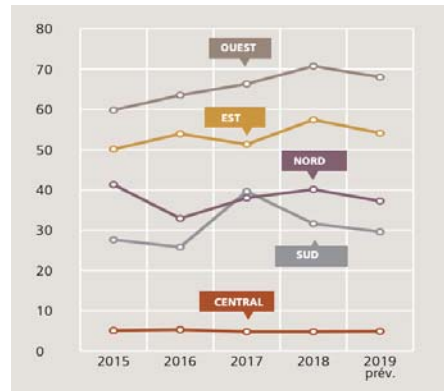
Depending on their nature, internal wars affect agriculture in various ways. Their impact depends on the characteristics of the country's agriculture. For example, in some countries, there may be a surplus of labour in rural areas, if this is the case, the loss of lives caused by war, despite their obvious human cost, will not affect the productivity of agricultural production. In other situations, there may be a shortage of agricultural labour, particularly during seasonal peaks. Another example is that livestock farming is extremely vulnerable in the event of war because animals are left unattended and diseases spread easily.

FAO's conclusions on this issue lead to a simple conclusion: the countries most exposed to conflict are often countries in which agriculture is a major component of the economy and where the majority of the population is rural. In such circumstances, the promotion of agriculture and rural development is not only a means to stimulate development and improve overall food security, but also a powerful means to reduce the risk of conflict. The establishment of strategic food stocks seems to be an obvious response to food insecurity caused by conflict, although it is known that this management is extremely costly, especially in times of conflict when transport is interrupted and silos become targets of choice for attacks. The construction and maintenance of storage facilities on farms in conflict-prone areas is a viable option only if these facilities can be protected and controlled and if it is possible to effectively distribute the food stored in areas in need.

### **2019 Harvests, a Stationary Assessment**

FAO's assessment for 2019 indicates that 41 countries around the world are in need of external food assistance. Of these, 31 are in Africa, 8 in Asia and 2 in Latin America. A country is said to be in need of food assistance when it is considered that it should lack the resources to deal with food insecurity issues itself.

Various factors can lead a country to find itself in such a situation, such as a lack of food availability, limited access to food, or a serious localised problem. These countries in need of external assistance fall into three categories: those facing an exceptional production deficit (bad harvests, natural disasters, etc.), those in generalised lack of access (a large part of the population is unable to buy food), and those affected by serious food insecurity due to the influx of refugees, the concentration of displaced persons, crop losses, etc.

**Figure 11:** World cereal production in million tonnes, French version, FAO website

According to FAO's assessment, cereal supplies in 2019/2020 will be more abundant than forecast. While it should be necessary to draw on global reserves, it should be much less than expected in order to meet the increase. World cereal production in 2019 is forecast at 2708 million tonnes, 2.1% higher than in 2018. Seed stocks were 1.8% lower than in 2018, which is still high, and once again points to good global availability.

Production in low-income food-deficit countries is expected to remain unchanged in 2019, mainly due to the fact that lower production forecasts in Sub-Saharan Africa are expected to be offset by higher results in Asia. Indeed, the decline in production in Sub-Saharan Africa is more pronounced in Southern and Eastern Africa. Why? Two major cyclones and a rainfall deficit for Southern Africa, and a drought in early 2019 for East Africa, which led to a sharp decline in production in some countries.

The situation in Zimbabwe is particularly critical, as the country must replenish its national reserves, which creates considerable external supply assistance and will de facto increase imports from the continent.

FAO estimates indicate that potential agricultural yields are expected to decline by 15-30% in Sub-Saharan Africa due to global warming. Closely linked to the growing problem of overpopulation, agriculture suffers from urbanisation. The construction of housing and various infrastructure is gradually taking place on the available arable land.

The challenges facing our agriculture today are sustainability. First of all, the primary sector must continue to fulfil its productivist function, under satisfactory competitive conditions and on a sufficiently large scale to meet the needs of the entire population. Secondly, this essential production activity must take place within a preserved environmental framework in order to manage our natural resources responsibly. Finally, it must ensure that its human dimension is taken into account, both in its health and social components. Competitive and qualitative production that respects nature and people is the challenge for agriculture. After analyzing food demands and agricultural resources according to the actors limiting the supply of demand, the study then presents itself with the avenues of reflection for the pursuit of sustainable agriculture.

### Understanding tomorrow's challenges

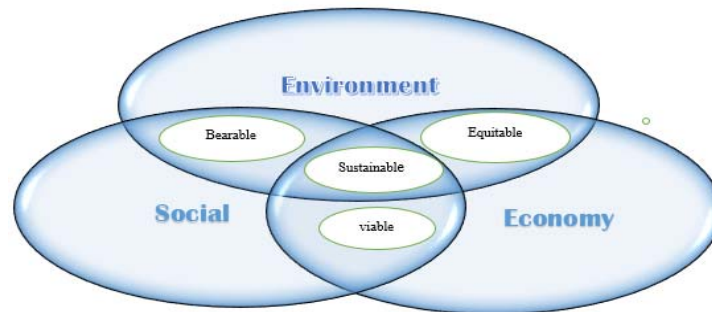
By 2050, according to estimates, there will be nearly 9 billions of us, in an energy, climate and environmental context that many « *Cassandra* » see as difficult, dark and even more, what solutions would be needed now to respond to them and to ensure healthy and nutritious food security for all?

What could be the sufficient and nutritious food and agricultural model to feed the population while preserving the environment? The challenge is daunting for all countries, but especially for intermediate and developing countries.

### The notion of "sustainable development"

Officially, according to the Brundtland Report<sup>26</sup>, summary of the first United Nations World Commission on Environment and Development, chaired by Norway's Gro Harlem Brundtland, sustainable development is officially, "a mode of development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Being concerned about the needs of today without mortgaging those of tomorrow requires the search for a balance between resources (natural or produced) and the environment. Sustainable development is therefore at the crossroads of three components: economic, social and environmental.

**Figure 12:** The three pillars of sustainable development (ADCNS)



The notion has evolved, new wordings: "green economy", "transition" or more controversial "decline" have been attributed to it. It has expanded, nowadays it would be closer to the idea of resilience. Many "ity" concepts are involved and feed the debate: sustainability, viability, equity, exclusivity... A debate which, with ecological thinking and movements, is constantly growing with a broader problem and a pluri and transdisciplinary approach to better understand the complexity of the phenomenon, provided that it does not add confusion and dispersion. Some question the concept, it would underpin a vision of development that is too Western and make it "*desirable universal development*" by rejecting other equally legitimate forms of development. Proponents of "degrowth" see it as a difficult dimension of economic growth to achieve, as resources are not unlimited. This is a somewhat partisan and restrictive view given the current scope of the concept and all the interrelationships and interactions it implies, at the risk of forgetting the original definition.

It is obvious that it is necessary to rethink our agricultural practices, our consumption, our lifestyles and our diet in order to move towards sustainable development that would guarantee a better future for the following generations. It would be futile to list suggestions and innovations in order to select only a few. The first question is the place given to population trends in the food system and development and the challenge they pose and will pose.

### **The demographic challenge in approaching the food system. How is the population theory of the "large number" in sustainable development perceived, what are the issues?**

From the beginning of the awareness of population growth at the end of the 18th and 19th centuries to the current debates on the future "exponential population growth", which has nevertheless been revised downwards, questions have been asked time and again. Its economic and societal impacts; its effects on resources and more recently on the environment are assessed in different ways.

With regard to the global discourse on demography, analysis, conditioned by a better knowledge of data, is evolving from the phenomenon towards the human level for a better adaptation to development. The perception of

the fact itself and the policies of coercion imposed is gradually being enriched by the notions of respect for the person, free will and individual rights. In the 1960s, growth was considered a "ticking bomb", and it had to be reduced because it was seen as a danger to development as a whole. The concern was such that in 1969, the United Nations created a specialised agency, UNFPA. Sometimes drastic family planning measures and programmes were then carried out in Third World countries such as forced sterilisation in India (since the 1950s) or in China, with the one-child policy (1979), against culture and religion.

Gradually and in view of the meagre results achieved, the policies implemented are being supplemented and adjusted with a more feminine component. The general trend will be to challenge defined and restrictive demographic policies in order to move towards greater gender equality, personal rights, women's empowerment and their place in development. This approach was based on *the United Nations Decade for Women (1976-1985)*. At the Budapest Conference in 1974, representatives of several countries speculated that the best contraceptive could be development, an idea that will continue to grow. In 1994, in Cairo, the International Conference on Population and Development (ICPD) was held, 179 governments adopted a programme of action for women, their health, their freedom of choice in sexual matters, etc. The 2019 report states that :

« *the 2030 Programme recognizes that sustainable development depends on the implementation of quality health services, including sexual and reproductive health, and respect for gender equality and reproductive rights.* »<sup>27</sup>

The report highlights the difficulties and obstacles to achieving the necessary resilience of populations and their interaction: "*Population dynamics shape societal conditions, and vice-versa,* » (Report cited p. 51). Demographic trends are not factually involved here but are integrated at their level into an entire system. It is also a way of justifying results that are not always the expected ones!

Many still believe that excessive population growth hinders development because, as has been said, poor regions experience high population growth rates. On the other hand, countries that are stable or declining are rich. François Ramada did not hesitate to affirm, in the 1980s, that "*the major catastrophe of humanity*" resulted from "*its anarchic reproduction*" and its "*exponential growth*". For economist and financier Ader Turner, president of the New Economic Thinking Institute, the decline is an opportunity for technical innovations, for the automation of tasks that will limit jobs. In Africa, where the population is mostly young, the future is uncertain and worrying.

It must also be noted that there is a growing awareness of the demographic challenge and the need to take it into account in order to save the planet, fight global warming, respect the environment and food security; a recent concern, especially in northern countries and among young people. We should regulate by "fewer children", "No Kids »<sup>28</sup>. We think of the Reverend Thomas Robert Malthus who, in 1798, in his *Essay on the Principle of Population*, formulated the asymmetry between the geometric progression of the population, very rapid if it is not slowed down, and the arithmetic progression of resources, much less rapid, hence the obligation to regulate. A demographic and economic theory that has stood the test of time, that has generated much debate and controversy. In the current context of future population growth and sustainable development, in the many debates that are taking place around the world, Malthus' shadow still hangs over demographics, over its possible political and ideological instrumentalization.

Emphasis is placed on population growth as "*one of the main factors contributing to environmental and even societal threats*". Population growth is reported to be one of the main factors driving the increase in global greenhouse gas emissions and carbon footprint. As early as 1992, a committee of the US Academy of Sciences established that development was strongly impacted by the link between family planning and greenhouse gas emissions. In France, Yves Cochet, an ecologist and former Minister of the Environment in Lionel Jospin's government, proposes to reverse the policy of encouraging the birth rate and reduce family allowances according to the number of children. A study by the *Environmental Research Letters* suggests the hypothesis of "having one less child" to reduce the carbon footprint. The number of statements and calls is increasing. On 9 October 2018, in the daily newspaper *Le Monde*, an appeal was published signed by some twenty scientists stating that "*curbing population growth is an absolute necessity*". On November 13, 2018, more than 15,000 scientists from 184 countries issued an

alarm call on the state of the planet that was widely reported by the media. Individual solutions have even been mentioned, some of them deciding — in the extreme - to do everything possible to avoid having children! In the United States, in 2018, the Ginks (Green Inclinations No Kids), considering that overpopulation had devastating effects on global warming, decided not to procreate to save the planet. Extreme positions that are not based on real science, at a time when the United Nations' prospects are being downgraded. In independent institutions such as the World Watch Institute, positions are more nuanced. Demographic pressure is not the direct cause of environmental problems, it is a factor of acceleration.

It is true that a better knowledge and understanding of demographic trends in the world and across regions, countries and their links with development objectives is essential, but will require time, resources and above all, beyond words, concrete actions.

### **Understanding tomorrow's challenges: a necessity**

We live today in a world that provides us with fabulous sharing tools to distribute our ideas, to distribute our most extravagant ideas, we have in our hands what will allow us to build the world in which we want to live, and help. So perhaps it would be appropriate to start implementing ideas before creating new ones. To really put these many ideas into practice, and at all levels, rather than continue to want to change them. Every day, millions, perhaps even billions of people who are invested, worried and passionate at the same time, use their thoughts and knowledge to respond to the ills we will all face, in a spirit of solidarity. It is in this sense that we bring to the public's attention some large and small ideas and innovations that, assembled one by one, could help the necessary agricultural transition of the 21st century.

Many initiatives, however divergent they may be, are linked to the issue of food security: the fight against waste, the fight against food insecurity, the fight against desertification, the promotion of the circular economy... all initiatives contribute to the emergence of new production systems.

Not wishing to use the term "revolution", the term "transition" in agriculture would be preferable here. Indeed, the word "revolution" has a particular historical trajectory designating a complete rotation, a total rupture with the old order, allowing the social or political progress of tomorrow. Certainly, it was a central concept in 19th century political thinking. Today, the term "agricultural revolution" seems to have a negative connotation, reminiscent of mass and industrial production, which seems to be on the margins of current demands. This is why we prefer to use the term "agricultural transition", which underlies the idea of a gradual transition to the establishment of appropriate responses to the inspirations and needs of society<sup>29</sup>.

It is essential to remember that there are, however, realities to be taken into account, for which no concrete solution is conceivable in view of their invisible and irrefragable nature. This is the case of urbanisation or urban sprawl, which consumes many pieces of agricultural land each year in the face of the irresistible circumstance of population growth and therefore of the evolution of food supply and demand.

An essential component of urbanisation is urban sprawl, which consumes millions of hectares of agricultural land, often of very good quality, each year for the construction of housing or urban infrastructure in all countries of the world. For instance, for the countries around the Mediterranean, the urbanisation rate is expected to increase from 64% in 2000 to 72% in 2025 with increasing coastalization of populations. Therefore, solutions can only be effective if they take into account the obvious realities of all kinds.

### **Agricultural innovation, from new technologies to the adaptation of existing processes**

Projects submitted to new food demands will only be efficient if they take into account a global and multi-disciplinary approach. These are multiple movements, but they all raise the same question about the future positioning and no longer of "the" but of "future" agriculture in all its diversity, according to their location and their own challenges. This is why it is fundamental to study the feasibility of each new project, according to the characteristics, particularity, strengths and weaknesses of each country or geographical area, which all have their particularities in terms of human capital, natural capital, physical capital (infrastructure such as roads, transport), financial capital (is

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the project really financially feasible for the country for which it is intended?), and finally social capital. These are the five assets of the Sustainable Livelihoods Framework (DFID 2001).

In a few words, develop sustainable agriculture, but in all its components. The sustainability of an agriculture is assessed through its environmental, social and economic, but also ethical components. Nevertheless, a sustainable agriculture covering all dimensions is rare, often with more or less components. Innovation is a complex process where multiple actors play different roles. In any case, agricultural innovation must take into account, according to the demands, the levels of knowledge and capacity of each entity, it must leave an important place to the learning and empowerment of agriculture

Agricultural innovation must be a process through which any actor implements for the first time and in a specific context, new or existing organisational or technical methods or techniques, in a particular context in order to respond to a specific problem, in order to increase the efficiency of food production in a sustainable component.

For example, agricultural and artisanal production often has a traditional image, with practices that are often frozen in time and passed on from generation to generation. Nevertheless, as demonstrated by the work of FAURE, G & CHIFFOLEAU<sup>30</sup>, innovation must be present at all levels, and not only on biotechnologies or artificial intelligence, etc. Indeed, a relevant analysis has been carried out, showing that local systems are also confronted with permanent innovation needs, to cope with both internal and external developments. Faced with these needs, it is necessary to organise adaptations between the actors, which then leads to innovations that can be technical or organisational.

One of the main current challenges for agriculture is to develop innovations that are qualified as responsible. Innovation in itself is no longer enough to legitimise the implementation of a new technology, it is no longer considered virtuous and is beneficial to all. A new moral requirement has emerged, largely as a result of the negative ethical consequences, which have sometimes increased the vulnerability of man and nature (Jonas 1990).

There are many French Start-ups promoting sustainable solutions in waste treatment or new agricultural production techniques. There are now more and more bio-degradable objects or the reuse and recycling of consumables in order to limit the depletion of natural resources and extend the life of objects. Rather than throwing it in the garbage, reuse.

Innovating to recycle shell waste into a new product for poultry feed, amendment, mulching and gardening is the credo of a young Toulouse (France) Start-up : *Providentiel Coquillage*. An original idea, among many others, to reuse shellfish from empty oysters and clams as fertiliser, poultry feed, in gardens against weed growth and soil protection against frost and damp heat. Transformed into a powder, it protects the soil from frost and heat, limiting evaporation by maintaining the soil's humidity and freshness. A pure and natural product obtained by crushing oyster shells. French start-ups are shaking up the green business, eating better, consuming smarter, preserving natural resources, cleaning up. Many companies are innovating in their own way to make life a little greener.

In 2019, the French government initiated the Green GreeTech, through the Ministry of Ecological and Solidarity Transition, which aims to develop new uses and services for citizens through the use of open data. This initiative invites Start Up and small / medium sized enterprises, to apply for calls for expressions of interest from the GreenTech. The label gives the winners the right to benefit from all or part of the support offered by the Ministry in this context, a label that gives credibility to innovative projects of decision-makers, investors or buyers, particularly public.

In any case, all solutions must be considered in their sustainable nature and in particular with regard to agriculture.

### **Solutions for sustainable agriculture**

In the light of recent history, examples of revolution, land rehabilitation projects, combating desertification, innovations and personal and collective actions can testify to the efforts made to find emergency solutions that can become sustainable in terms of their possibilities and limitations, and inform us and enable the necessary actions.

### The reality of the Green Revolution in India and its future

India, where in about 50 years, while the population has tripled, grain production has quadrupled, is a singular example. The results first challenge the theory of the brake on growth expressed above, and would support Esther Boserup's (1965-1981) counter-theory. This Danish economist has reversed Malthus' paradigm by humanising economic processes, focusing her discourse on men and women, their ability to adapt and rebound. For her, population growth in rural areas would be a springboard for progress and productivity through more intensive use of technology. A downside, however, with poorly mastered and adapted techniques, the result is risky.

The least developed countries - which served as its laboratory - allowed it to present its different theories using real facts. India would be an example.

Without going into India's history since its independence, it is important to identify its main lines. On August 15, 1947, India's emancipation was accompanied by Pakistan's secession. A period of terrible unrest then began: exodus, (nearly 10 million) inter-ethnic and inter-religious struggles (Hindus, Muslims). On 26 January 1950, India officially became a republic; it embarked on its own unique path of "democratic socialism". Between deeply rooted traditions and modernity, the path of development will be difficult and singular for the country. Until independence, food production grew at a rate ten times slower than the population! Nothing was taken for granted for the necessary modernisation; shaking up customs that had been ingrained for millennia was not an easy task. For the approximately 361 million inhabitants of that time, the agrarian question was crucial because the spectre of famine was never very far away. In those years, India had a large food deficit. The food being mainly composed of cereals and legumes (food-grains); more than half of the population was undernourished (United Nations estimate: 1620 calories/day and 42 g of protein); a very gloomy picture despite the country's potentialities! For Gopalaswamy, the author of the 1951 census report (considered too alarmist), there should be a "*near miracle*"; for him, there is an urgency in the agricultural sector.

In the early 1960s, India's situation became more serious, especially since it was part of an Asian context of war (Vietnam), conflicts (China) and rivalries of all kinds. In addition, in 1965 and 1966, agriculture, which was very sensitive to the whims of monsoons, suffered the effects of a very severe drought. Ensuring self-sufficiency then became a major political issue, urgent decisions were required. In the field, the Green Revolution has resulted in a set of agricultural innovations developed by Indian and foreign researchers and agreements with the Rockefeller and Ford Foundations<sup>31</sup>. New varieties of high-yield cereals (rice, wheat), delivered free of charge, have been introduced. Better developed techniques, intensive irrigation, appropriate mechanisation combined with the increased use of chemical fertilisers and pest control treatments increased yields.

The economic effects of the Green Revolution have been spectacular. Productivity and yields have been much better than expected: rice has doubled and wheat has tripled. Food self-sufficiency achieved, food shortages and famine disappeared. Today, India is one of the four largest agricultural powers in the world. First for its production of milk (white revolution), protein crops; second for rice, wheat, tea, cotton, sugar, fruit and vegetables, fisheries and aquaculture. The country has become an exporter, the first for rice, beef and spices. Nevertheless, in the absence of a major agri-food industry, the country does not take advantage of its agricultural wealth to provide jobs. In India, traditional activities are still privileged.

India's success is due to the collaboration of many actors. The Indian government has invested in infrastructure, agricultural research centres including the Indian Agricultural Research Council (ICAR), fertilisers, rational mechanisation, hydraulic system for intensive irrigation. It has provided subsidies and credit support to farmers. It has set up a whole institutional system: the Agricultural Prices Commission (APC), the Food Corporation of India (FCI), and the Public Distribution System (PDS). Thanks to the World Bank and international support, Indian farmers have been able to invest in intensive agriculture. Multinational companies — such as Monsanto - have invested heavily in Indian agriculture (GMOs, fertilisers and chemicals).

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The Green Revolution has not been easily accepted by everyone except the wealthiest, and by all regions. Socially, the rich have become richer and the poor less poor. The first regions were those of the North-West, the deltas of the South-East that already knew irrigation: the "*Green Revolution belt*" Punjab, Haryana and western Uttar Pradesh... In these regions, tensions and conflicts have eased as they persist where the Green Revolution has been less well adopted, such as from Nepal to Tamil Nadu "*The Red Corridor*".

This agricultural system has made food security possible, but at what cost! It is neither socially equitable nor environmentally sustainable. The Green Revolution outside its cost has perpetuated, if not created, social inequalities, a critical debt that has led to many suicides. In addition to creating wide disparities and inequalities between productive farms and food crops, it has reinforced regional inequalities: between South India, Punjab and Bengal on the one hand, and a north-western/southeastern band from Rajasthan to Odisha where strong social structures still resist. From the 2000s onwards, yields stagnated while food demand continued to increase, with agriculture's share of GDP declining (to around 17%). There are still 190 million people undernourished, one in six is malnourished. Food security therefore remains an essential issue. In this context, in 2013, India adopted the Food Security Act, the world's largest food distribution programme, benefiting nearly 820 million people<sup>32</sup>.

As for its effects on the environment, they have been disastrous and worrying: pollution and serious ecological risks, in particular degradation, erosion and pollution by chemical inputs to the soil. Rice cultivation, which consumes a lot of water, combined with water-intensive measures and a water-intensive hydraulic system, and climatic hazards have caused a critical drop in groundwater levels, and inputs have polluted them. The founder of the Green Revolution, Monkombu Sambasivan Swaminathan himself stated that "*industrial agriculture pollutes the environment and has made peasants slaves to agri-food companies, which pushes them towards consumption*"<sup>33</sup>

This first green revolution, in many ways, is not part of sustainable development but rather of emergency development that involves further reforms, research and innovation. It should be remembered that India is a singular country, excessively complex. It would be futile to try to repeat the model in other countries such as those in Africa in the same way, if not to adjust it substantially.

The "green revolution" has taken up the challenge of food, but it has reached its limits. The stability or even the current decline in yields raises concerns for the food situation. The demand is for "ecologically intensive agriculture". Swaminathan himself mentioned the need for a "second green revolution" or "doubly green" that would overcome the obstacles of the first, through new technologies, the cultivation of GMOs and greater diversification of production. By taking advantage of the resources available on the spot, it should be part of sustainable development by respecting the five "E's": Ecology, Economy, Equity, Employment, Energy": an "Eco-technology". What would deserve to be popularised in many places: a "socially acceptable" agriculture that is sustainable, integrated, adapted to geographical and climatic constraints.globalisation

The countries in the world that have resolved their food situation have followed the same approach, the commitment of the State, a well-defined and responsible agricultural policy, financial and human investments, resources made available to everyone and a whole set dedicated to research, training and extension. In this sense, the Green Revolution has been rich in positive and negative lessons.

### **The basic objective of restoring fertility to the land, the action programme to combat desertification**

It is difficult to implement all the above if the soils are not in fact fertile, due to climatological, anthropological or other factors.

The new agricultural trends mentioned above are often Western-initiated, in opposition to the principle of food globalisation. Certainly, it is necessary to undertake the same behaviours in countries where food insecurity is currently proven. But the issues are different. Indeed, the globalisation of agriculture is by no means comparable to a European or American country. Take the case of the African continent, there are many actors advocating development and assistance to small local farmers and family farms. The principle is honest and beneficial, but unfortuna-

tely, it is not appropriate and not adaptable to all African regions. Local agriculture in Africa (for example) faces a different problem from those previously seen in mainly Western countries: that of soil production capacity. Therefore, the rehabilitation of African lands is a priority preliminary step, in the current state of the continent's soils, to be applied. An elementary step is required: soil restoration, which to be fertile and allow plant growth, must have good biological activity.

In this sense, a remarkable project has been initiated by the African, Caribbean and Pacific Group of States (ACP): action to combat desertification. The challenge is simple: to improve the productive capacities of certain countries by increasing their resilience to climate change, particularly against desertification and soil drought. Eight countries are involved in this project: Haiti, Senegal, Gambia, Burkina Faso, Niger, Nigeria, Ethiopia and Fiji.

The problem is significant, in fact, according to the FAO, each year 24 billion tonnes of arable land are lost due to erosion and 12 million hectares are degraded, which corresponds to 23 hectares per minute...

The project, launched in 2014, is linked to the Great Green Wall project, the African continent's flagship programme to combat desertification since 2007, adopted by the African Union. The creation of a vast mosaic of green and productive landscapes across Africa, it brings together more than 20 countries located in North Africa, the Sahel and the Horn of Africa. As the project programme explains, it should not be seen as a wall of trees holding back the desert, the wall is only a metaphor for expressing solidarity between African countries and their partner. In a nutshell, the project is intended, like RED, to make degraded land productive again. Indeed, the expansion of the Sahara is estimated at about 2 kilometers per year and threatens the continent's green areas as well as entire countries such as Tunisia, 75% of whose arable land is threatened by desertification. It must be understood here that desertification is not strictly speaking the desert that is gaining ground, it actually originates from overexploited soils that end up drying up and no longer being fertile, to such an extent that they end up gathering in the desert sand. In fact, it is erosion that makes sand, and it is a phenomenon that often occurs on the edge of the desert. So, to counter this environmental disaster, the project proposes a "forest barrier" 7,800 km long and 15 km wide, involving 11 African states.

Let us take the example of the intervention of the RED project in Ethiopia. According to the report published in 2018, socio-economic surveys revealed that only 12.8% of the land in the intervention area was classified as cultivated, ranked third after grasslands (13.2% of the territory), and "other land" representing 72%, mainly bare soil. 61% of the total area of the territory concerned needs to be restored, or 3,881,308 million hectares. 64% of project respondents reported having suffered from food insecurity during the 12 months preceding the survey.

This project is an admirable initiative that has resulted in the restoration of 18,000 hectares in Africa, with the use of 1,500,000 plants that have benefited 500,000 people. It is also 1,250 hectares restored in the Caribbean. A robust and proven land restoration approach that must be scaled up to a very large scale to meet the immense and growing need for restoration in the rest of the world.

### **The promotion of short circuits, highlighting local agriculture**

In recent years, there has been a resurgence of movements based on local food economies and the development of natural, cultural and human resources. The notion of "short circuit" and proximity has become universal, as has the consumption of so-called local and organic products.

Nevertheless, even if these movements are mainly based on the initiatives of local actors, globalized and local actors operate on the same market. It is no longer a question, therefore, of fighting against the globalisation of trade as a matter of principle, but of calling into question the principle of universal sovereignty in the field of free trade. Indeed, agricultural and food markets need to be regulated and controlled, if possible within the framework of international agreements or bilateral regulations, and in any case by national public policies to defend local economies to promote local production and actors.

In this sense, some authors distinguish two main groups of sustainable agriculture, the strong ruptures and the partial ruptures with productivist agriculture of globalisation. Indeed, the strongest breaks are characterised by organic farming, and to a lesser extent, so-called "peasant" agriculture and reasoned agriculture where the breaks are only partial. It is true that today, organic farming is the archetype of sustainable agriculture, it is forbidden to use almost all industrial inputs. Organic farming, appeared in France in 1970 in response to the rise of productivist agriculture. Strict production conditions mean that yields are 30 to 40% lower than conventional agriculture, which implies higher prices, which unfortunately do not currently make it possible to meet the economic criteria of sustainable development, since they are mainly consumed only by wealthy consumers, because they are associated with

the concepts of purity, health and harmony with the environment. Despite the dynamics, it is practiced on only 1% of the world's agricultural land. So, if it has many virtues, it does not have the power to feed the world. An emblem in sustainable agriculture, of course, but despite these advances it only plays a marginal role.

The so-called "reasoned" or "integrated" agriculture, which takes into account local specificities, is much more financially accessible. This type of approach, which is highly controlled, aims to respect the laws of soil biology and create dynamics of complementarities between the different components of a crop. The AR label was introduced in France in the 2000s, and is often considered as a transition between intensive and organic agriculture. For its supporters, it would facilitate a transition and ultimately a conversion of intensive agriculture.

Short channels such as direct farm gate sales or local producer and counter stores, AMAPs etc are also appreciated. The aim is to considerably reduce the number of intermediaries, i.e., the "food mile" between the farmer and the consumer. For farmers, they allow an increase in margins thanks to a direct or almost direct remuneration of the producer.

### **Food waste, a struggle both individually and collectively**

Food losses and waste have become a major concern for the public. The internationally agreed 2030 programme for sustainable development reflects the growing global awareness of the subject. Indeed, target 12.3 of the SDOs aims to halve global food waste per capita at the retail trade and consumption level by 2030, as well as to reduce food losses along the production and supply chains. Since 2011, FAO has created two separate indices: the Food Loss Index (FLI) and the Food Waste Index (FWI).

FAO defines food losses as "*the decrease in the quantity or quality of food resulting from decisions and actions taken by food suppliers in the chain, excluding traders, food service providers and consumers*". In other words, it refers to all food discarded, incinerated or otherwise disposed of throughout the food supply chain, from harvest, slaughter or capture to retail sale. Food losses as mentioned above occur after harvest and retail sale.

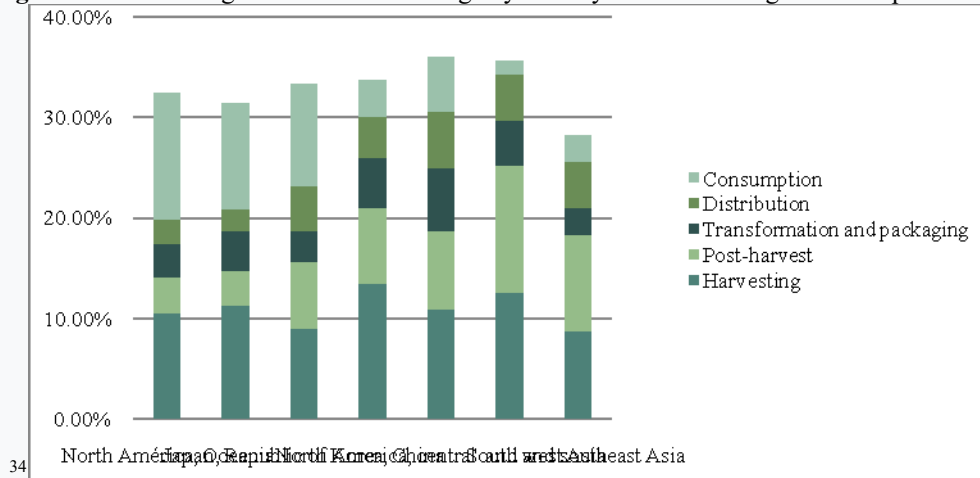
Food waste, according to FAO, refers to "*the reduction in the quantity or quality of food resulting from decisions and actions taken by traders, food service providers and consumers*". In other words, these may include fresh products that do not meet standards, foods that are close to expiry dates, large quantities of unused healthy foods that are thrown into the kitchens of homes, restaurants, etc.

Not to mention that reducing food losses and waste is an essential condition for achieving the goal of a Zero Hunger World and the SDOs, including 2 (eradicate hunger) and 12 (ensure sustainable consumption and production patterns).

FAO is strengthening respect for food, for the farmers who produce it, for the natural resources that allow it to be grown and for those who suffer from food shortages.

To date, FAO estimates that one-third of the world's food is lost or wasted along the food chain, from production to consumption. Fortunately, in recent years, these issues have received great attention and high visibility.

Depending on the products and regions, the distribution of losses and waste along the food chain is very different. In general, in middle- and high-income countries, much of the loss and waste occurs in distribution and consumption, while in low-income countries it occurs in agricultural production and post-harvest. For example, in Africa, losses affecting cereals occur mainly at the early stages of the food chain, while in Europe they occur mainly at the consumer level: 25% of cereals wasted at the consumer level compared to 1% in Africa...

**Figure 13.** Percentage of losses and wastage by country at different stages of food production

In any case, the great diversity of causes acting at different levels requires a wide range of solutions, which must also be structured by levels. We will present some of its waste reduction solutions

Increased consumption of processed foods, urbanisation, longer supply chains, and fewer personal contacts between producers and consumers are making consumers increasingly turn to labels for information from advice on product freshness and shelf life. The dating systems are multiple and varied, but what dominates is the confusion about these dates. Various studies<sup>35</sup> have pointed out that the dating of food, and the confusion it causes, is one of the main indirect causes of loss and waste caused by consumers, since consumers tend to consider that dating gives an indication of the safety of the product when it most often targets the quality of the product.

Expiry dates now seem to be an outdated idea. The famous deadlines have certainly to be rethought, but also, the Franprix brand has tested an innovation in this area: intelligent labels, which change colour or texture when the product approaches its expiry date, to make the product easier to use. The idea of "happy hours" in supermarkets or the promotion of so-called "anti-waste" shelves is to be developed and has also proved its effectiveness, as products approaching their expiry date are sold at a lower price. Leclerc has also set up soup ranges made from "ugly vegetables". Others have made salads of them, upgrading seafood products or grouping « solitary bananas » to increase the chances of sale.

However, it is true that products lose their economic value as they no longer meet the quality criteria that make them marketable (even if they remain perfectly edible for most of the time). However, this discount system for this type of food is not viable if the store or retailer's management model is based on emphasising the quality of and freshness of the products. However, there are other distribution systems that seek to give value to their products, such as food banks, for example, and non-governmental initiatives have developed into associations that collect food for distribution to people in difficulty. In traditional models, wholesalers, supermarkets, etc., give low market value inputs (dormant stock, production surplus, product sales date exceeded...). There are many reasons for these donations, processors may donate products with packaging and labelling problems, etc., distributors may donate products that are losing or about to lose their commercial value (near the expiry date or damaged fruits and vegetables). The proper functioning of these banks depends on coordinated action by the actors in the sectors (information on the existence of the donation, setting aside, transport, etc.). The French Startup COMERSO or PHENIX are excellent intermediaries helping to promote unsold products. The other startup, ZERO GACHIS, lists stores offering "short dates" food.

It is also difficult not to mention here the French StartUp TooGood To Go, "*the mobile application for a world without waste*". The whole principle of Too Good To Go is based on the surprise basket, made up of the unsold items of the merchant's day. Unsold products are only fresh products that merchants can no longer sell tomorrow, even at very advantageous prices.

This initiative concerns both the consumer and the restaurateur, who plays the game. Indeed, food services in the hotel and restaurant sector have a dual role to play in this control strategy: reducing their own losses and waste, and using their strategic position to raise consumer awareness, understand their behaviour, etc. The evidence then shows that the most effective solutions are to combine strategies that also target consumers. Such as the "a kilo" restaurants in Portugal and Brazil, where the consumer pays for the food they eat by weight, an incentive not to waste because the consumer becomes aware of what he could have saved. Halfway between the Start up To Good To Go initiative or the "a kilo" restaurants, another idea could be to offer a menu with smaller proportions, for a more modest price, or with food at the end of its life.

De facto, it is easy to see the growing development of initiatives around the world to combat food loss and waste at national, regional and local levels. In recent years, several countries and initiatives have been launched and have sought to raise consumer awareness of the importance of reducing losses and food waste.

Each actor must and is able to take the initiative, either individually or collectively. The current data are encouraging.

It is clear from all the above and just mentioned that education and its implications, namely training and extension, play a key role. "Sustainable development begins with education: how education can contribute to the proposed post 2015 goals" was the meeting programme in 2014 (UNESCO). Its role is fundamental for rural populations in developing countries to restore their confidence and engage them in sustainable development. What exactly is the situation?

**To ensure a healthy and nutritious diet and maximise agriculture, three pillars are essential: education, formation and popularisation.**

The stagnation of rural living conditions in developing and least developed countries is a brake on the economy in general. It is not our intention to engage in a philosophical-ethical debate about the controversial commitments and aims of education in developed and less developed countries and its difficulties to measure effects. Likewise, it is not our intention to mention the major economic theories, nor the macro or micro economic effects of education. The key is to understand what, in the context of sustainable development, could be considered in the field of education for agriculture and food so that all can live decently.

Economic improvement in poor and rural areas can only be achieved through these three pillars: education, formation and popularisation, the impact of which will be verifiable at all societal and economic levels. For Louis Malassis (1918-2007), an OECD, UNESCO, FAO consultant, quality training and increased popularization were one of the main ways to integrate farmers today. His books deal mainly with European countries and he gives guidance for developing countries through exchanges and cooperation.

Target 4 of the SDOs is to ensure that all young people and adults will have mastered literacy and numeracy by 2030.

According to UNESCO, in 2018, there were about 750 million illiterate adults in the world, being 16% of the population, including 115 million aged 15 to 24. Data that are difficult to identify should be taken with caution. The overall trend is downward, but not enough to be significant. There are significant inequalities among regions: 450 million in Asia, especially south and West Asia (51%), 190 million in sub-Saharan Africa (25%), 12% in East Asia and the Pacific, 7% in the Arab States and 4% in Latin America, while 1% remains for developed countries, indicating that, it is more a question of illiteracy. More worrying is female illiteracy, which represents 63% of adults and 59% of the 115 million young people. A large number of women are, for social and religious reasons, excluded from the school system. Achieving the ambitious target of the SDOs by 2030 is still far from being done. If nothing is done to force progress, one out of six children aged 6 to 17 will remain excluded and only six out of ten will com-

plete secondary school<sup>36</sup>. However, education, teaching and training are essential to strengthen the resilience of populations in general and rural populations in particular. Especially since as the North ages, the South becomes younger and in sub-Saharan countries there are countries with the lowest median age. In Niger, inhabitants 1 to 24 years old represents 69%! We must absorb this young audience, which can be an asset or a handicap.

**Figure 14.** Projected number of female illiterates by region and age group, for the year 2015

	15 years & over		15-24 Years		25 - 64 years		64 years & over	
Arab States	28 906 550	-	2 450 760	-	21 076 070	-	5 379 720	+
Central and Eastern Europe	5 049 340	-	442 500	-	2 851 140	-	1 755 700	-
Central Asia	97 030	-	17 090	+	33 150	-	46 790	-
East Asia and the Pacific	52 472 390	-	1 549 530	-	22 426 500	-	28 496 360	-
Latin America and the Caribbean	17 293 420	-	928 780	=	10 870 890	-	5 493 750	+
North America and Western Europe	546 260	-	6 360	-	127 240	-	412 660	-
South and West Asia	235 846 500	-	24 882 670	-	172 395 100	-	38 568 730	+
Sub-Saharan Africa	72 806 730	+	17 222 910	Très légère diminution	46 897 020	+	8 686 800	+
World	413 018 200	-	47 500 600	-	276 677 100	-	88 840 510	+

*Note :* Table constructed from the table in UNESCO Institute for Statistics: *International Literacy Statistics: A Review of Concepts, Methodology and Current Data*, p. 45. (Some data is not very reliable). The + and - signs indicate the increase and decrease compared to the year 2005

In developing countries, the majority of the population is still rural and agriculture is the main activity. The same goes in all countries, but here, transgenerational resistance activates conflicts with greater intensity. In These rural areas, we note with regret that the school system is deficient and the duration of school very short. The lack of structure and the dramatic lack of competent teachers in many countries in conflict or war is detrimental to all levels from family to nation. In addition, education for managers and qualified personnel, is often inadequate, although it is vital for rural life and its future. Investments, which would ensure a profitable return for all, are slow. The map of illiteracy covers the lack of economic knowledge in agriculture and coincides with poverty and malnutrition in Africa, the Middle East and some Latin American countries. It is necessary to assess the intellectual investments that must be made, to know the rural social environment of the regions concerned and the social and economic elements.

Moreover, it is obvious that projects, proposals, programmes and plans do not sufficiently promote human participation. The development of human resources must be a priority in all minds and must meet needs; appropriate needs otherwise they will be refused or poorly accepted, which is the same thing; in any case they will not be in the direction of development and in the awareness of its urgency. This implies knowing the society in which you are interested and your heritage. Men and women must enter the circuit; it is on them that we must act, make them capable of exercising over their production, their food, their future, in a world that they will be able to protect. Educa-

tion is essential here in the act of learning and education. There are of course planned educational programmes, but education and training must be adapted to the agricultural environment and to that of the country and the region.

School enrolment in these regions poses a double source of problems that are not easy to solve if not through heavy investments, which, however, will have to be made. It should be noted first of all that in developing countries children are a source of income through the work they can do, hence the tendency to withdraw them from the school circuit in contravention of the law of obligation. The second point concerns educated young people who prefer to move to the city and end up increasing the number of unemployed, crowd themselves into slums or move abroad believing that they will find elsewhere the means to live up to their expectations.

Slowing down the rural exodus and its inherent cohort of consequences, maintaining to a certain standard, restoring value to rural areas is a priority. Erasing the entire pejorative environment that is attributed to rurality throughout the world is essential. Addressing the lack of managers and skilled labour is a prerequisite for growth. It is certainly not a given, since there is too much resistance, but it requires the establishment of a school infrastructure, an appropriate quality education. Reflection must be based on two axes; that of basic education, in order to restore meaning, improve people's living conditions, and protect human potential with basic knowledge. Similarly, learning to eat, to respect hygiene, food safety, arebasics concepts that must be known very early on. Health and nutrition education at all levels is therefore crucial. The second concerns the dissemination of knowledge and techniques, their popularisation and training for adults and farmers throughout their working lives to adjust new data and technologies; adapting new varieties for better nutrition, etc... to speed up their training because the tool is far preferable to theory. This is one of the main conditions for increasing motivation, productivity and performance. This will avoid importing methods that may offend ancestral traditions or turnkey models that will be misused and useless. But we must also provide ourselves with the means to create a whole network of jobs linked to the agricultural sector on the spot, which would make it possible to establish the rural population and especially the young people, those who will be better able to adapt to modernisation and associate it with traditional knowledge.

Let us not forget the women in rural areas, their presence can be seen in the fields, they represent almost half of the agricultural workforce. They play an important role in food agriculture, but increasingly they are directing their horticultural, fruit and flower production towards the European and world market. Their contribution is important in rural enterprises, which must be developed. The phenomenon of male migration has made them heads of families and farms. Nevertheless, the status of women, regardless of what the law says, has not changed in relation to land and access to resources. With many variables, their rights are subject to ethnic customary laws. In this context, it is essential to empower them, to provide them with training, to give them the opportunity and means to know their rights through education, to empower themselves, to be at ease with the choice of their fertility, to participate in the economy and therefore in development. They are able to ensure food and nutritional security and can have a definite impact on peace, as they prove every day in Africa. They have the capacity and the will to change the situation. Besides, don't they say: "*Women are the future of men* »!

Beyond the agricultural sector, the relationship between education and growth is obvious and crucial and, as the United Nations rightly believes, education is the cornerstone for achieving other sustainable development goals. It should make it possible to lift people out of poverty, reduce inequalities and create a climate of peace and tolerance in every society, which can only be achieved in the long term; countries must also provide themselves with the means to do so.

It should be noted that awareness-raising must also take place in developed countries. Indeed, this study has shown a strong increase in malnutrition in our countries, and the agricultural consequences it has had. This is why food and nutrition education must be put on the agenda. The promotion of healthy eating habits throughout life and the explanation of the agricultural and health consequences of "Junk Food" should be developed among the new generations. While such nutrition education must take place in all countries, it is not only about learning about food and nutrients, but also about how to act to improve nutrition and reduce food insecurity in the world. There is therefore a need to raise consumer awareness of quality food in terms of health and environments, as well as the social conditions of workers throughout the food chain. « "

In many areas, a lot of awareness campaigns appear on television and radio every day, focusing on "*eating a balanced diet for your health*" and "*eating five fruits and vegetables a day*". This approach is not useless, but it remains insufficient because they come up against their own limits: the daily reality. Many studies have tried to explain the obstacles to the successful implementation of these campaigns, and, in the vast majority of cases, fruit and vegetable consumption is hampered, for example, by questions of price, time and culinary know-how... which are strong vectors for information deficiencies and control of primary products. In addition, through these campaigns,

balanced nutrition is approached from the perspective of an obligation with the use in France, of the imperative for instance. However, this is a rather negative approach, and the notions of pleasure should be developed in order to clarify a new food culture, with is fundamental but today strongly troubled by food transition. On the other Hand, let us take the example of road safety campaigns in France and many other countries. In recent years, road safety awareness campaigns have been presented in the form of short films of a few minutes each with increasingly violent scenes since 2002. A recent survey showed that awareness campaigns through emotion and sharing have the greatest impact on awareness. Therefore, it is the testimonies that would have the greatest impact on the spectators' emotions. This type of campaign makes it possible to reach more deeply and show the various consequences of a fact. It raises awareness and compassion. It's necessary to communicate strong messages through emotion and empathy.<sup>37</sup>

Trying to influence food demand calls for the establishment of a real awareness of "eating well" among the youngest. A balanced diet is built from an early age. The role of parents is essential, since a child does not acquire his own eating habits, parents are the guarantors of young children's health and must help to develop good habits. But to act, it is necessary to understand, and for that, it is essential to know. Education must therefore be available not only on eating habits, but also on what is caused by poor nutrition, and above all on the current state of the world in the agricultural sector. A global awareness is needed, to understand the issues of tomorrow, and to raise awareness, without alarming. It is important to remember that food and agriculture are real issues for the whole society.

The Ministries of National Education and Agriculture and Food in France rightly recalled in a report on the education and nutrition of young people in 2018:

*« Food education covers many issues that are important for the whole of society: public health, the environment, land use planning, the agricultural economy, social justice and citizenship, culture and heritage. It therefore represents a social project. »*

The issues are consequently not only public health, but also social justice and training in citizen solidarity. As a consequence, it is certainly essential to carry out a transversal awareness, both physiological on the dietary balance, which is essential for good health and well-being, but also environmental, i.e., on the impacts of food practices on the environment (learning the concepts of "food miles", tackling waste issues, talking about world food situations, etc.). It's necessary to create cultural education on the culinary heritage, on the conviviality of meal times, on food and related religions, or on foods at training citizens capable of adopting responsible behavior in their daily lives, with regard to their health, but also towards the environment and the foreign societies concerned.

## Conclusion

This study reveals many paradoxes and dilemmas that require emergency solutions. One that should monopolize all attention is that of undernourishment. Famine needs to be differentiated from malnutrition, as well as the gap between over- and under-nourishment. Some have too much, other don't have enough. This assessment should raise questions. Food exists, it is sufficient, agriculture still has an encouraging potential, but millions of people remain by the wayside of the road! The fundamental right to food is not recognized for them; its application is slow and accentuates doubt and scepticism about the SDOs and "zero hunger » policy by 2030, as it has been for those of the Millennium. Anything that can be envisaged can only be achieved in a stable social and political climate, which is far from being the case in many developing countries.

While there is some improvement (many have been able to move towards sufficient and nutritious food) there are still too many of and the challenge could be difficult to meet if we do not take the measure and act accordingly. Only concrete actions will be able to meet expectations: the will must be combined with power. Food and agriculture play a fundamental role in the future of the world, and many economic, social and political obstacles, both endogenous and exogenous, are at work. Too many interests at all levels - international, national, regional and local - undermine this basic axiom, which can endanger our human heritage and our future.

Food, in this context, is becoming a vital issue for all humanity and for sustainable development. The solutions do exist, some avenues have been raised, some of which have been implemented with profit. It was often stressed that it was necessary to adapt decisions and projects to the country's conditions, resources and means, and to move towards effectiveness, efficiency and resilience. It is essential to establish sustainable actions, programmes

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and concepts that can be adapted to all the contradictions and internal tensions of the societies concerned and of countries where the most modern institutions coexist with the most traditional ones. The idea is not to reject globalization. While it has many shortcomings, it also has its merits for innovation, technology, assistance, adaptation, constraint measures and regulation. And people and countries need globalization to increase their purchasing power, which is the fuel for change and hereby gain access to food.

There are many debates that fuel questions about demographics : its growth or not; about growth theory in general or decline; other about climate with all exasperations and alarmist theories that are more or less proven. Today, action would be better. The certainty is that we all must permanently change our way of life, permanently, review the content of our plates, question the consumerist model. Beyond that, we need to rethink global agricultural production in order to increase the quantity and quality of food available to all, while respecting the environment. If nothing were done in this direction, what would be the point of reducing population pressure?

Developed countries also have an important role to play. On 17 October this year, FAO and Danone signed a Memorandum of Understanding to inform, provide the necessary knowledge on nutrition and food security and « ... *promote responsible agricultural value chains to support the development of more sustainable food systems.* » (Mr. Qu Dongyu, Director-General of FAO, at the time of signature. Info published by FAO). Aid is necessary, and the one provided is not always sufficient, some Northern countries reduce it, it does not always contribute to the development of the country, its "food sovereignty", a concept to which we have preferred "food security". Aid must be accompanied by the provision of knowledge and information, and this is where the research that is most often confined to its laboratories should take place; doing outreach work would be vital for the countries concerned but also for others. Training is a priority in rural areas, hence the importance that education should have for the rural populations of these countries. A coherent and competent educational structure would provide them with the necessary foundations for their development. The focus must be on this implementation in order to move the cursor towards more "human capital" development.

Another important point is foreign investment, which should boost developing countries provided that the return benefits the population. While African countries are concerned, most suffer from a lack of infrastructure essential to connect regions, cities and countryside. Rather than investing in an infrastructure that essentially allows agricultural production to be easily channelled abroad, to the country of origin of these funds, would it not be better to think about the well-being of the population and thus expand the aid provided, which would not be perceived as neo-colonialism?

Finally, emphasizing everyone's responsibility is a priority. The hand stretched out to help must meet the one who needs help, reciprocity here must be the order of the day. Action and inertia do not go together, the two cancel each other out. In this case, the citizen must reclaim the food system. And as previously noted, "we would expect everyone to participate, to make a responsible commitment, to a land of solidarity" and it is in this sense that the objectives will be achieved and that if a sustained global agriculture respectful of sustainable development alleviates hunger, many tensions will decrease.

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